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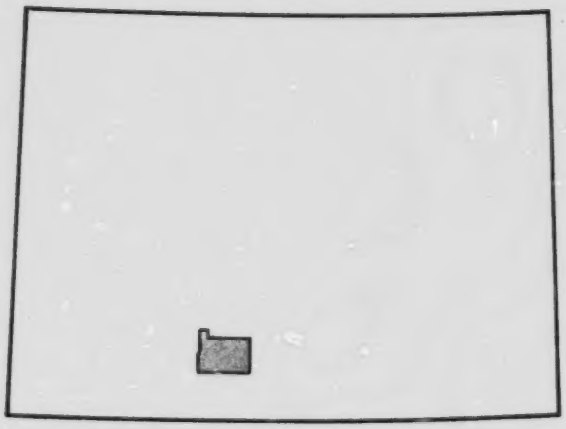
FLOOD INSURANCE STUDY

ORIGINAL



RIO GRANDE COUNTY, COLORADO
UNINCORPORATED AREAS

MAY 19, 1987

Federal Emergency Management Agency

COMMUNITY NUMBER - 080153

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NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for flood plain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the unincorporated areas of Rio Grande County, Colorado, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR 60.3.

This Flood Insurance Study was prepared by compiling existing hydrologic and hydraulic technical and scientific data. The data were identified as the best available at the time of compilation of this Flood Insurance Study and should depict the general conditions of the flooding sources with relative accuracy. The Federal Emergency Management Agency (FEMA) performed a cursory review and accepted the data as valid for purposes of this Flood Insurance Study and the NFIP. However, if better information is known to exist or has been developed since the date of this study, the information should be immediately forwarded to the address below for consideration for revision of this study:

Natural and Technological Hazards Division, FEMA
Denver Federal Center, Building 710
Box 25267
Denver, Colorado 80225-0267

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for portions of this study were performed by Camp, Dresser and McKee, as reported in the Flood

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Insurance Studies for the City of Monte Vista and the Town of Del Norte, Colorado (References 1 and 2). Additional analyses for the other detailed-study areas were performed by the U.S. Soil Conservation Service, as reported in the Flood Hazard Study for South Fork, Colorado (Reference 3). This study was completed in 1985.

1.3 Coordination

In a memorandum dated May 17, 1985, the FEMA Regional Office in Denver, Colorado, requested that a Flood Insurance Study be prepared for Rio Grande County, Colorado. This study uses information presented in the effective Flood Insurance Studies for the incorporated areas of the City of Monte Vista and the Town of Del Norte, and existing data from a Flood Hazard Study for portions of the Rio Grande and South Fork Rio Grande in the vicinity of South Fork, Colorado (Reference 3). A final coordination meeting reviewing the findings of this study was held on May 5, 1986.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers Rio Grande County, Colorado. The area of study is shown on the Vicinity Map (Figure 1).

The incorporated areas of the City of Monte Vista and the Town of Del Norte are included. A small portion of the City of Center, Colorado, lies in Rio Grande County, but is not included in this study. The Rio Grande National Forest, the Monte Vista National Wildlife Refuge, and undeveloped areas, which have little or no potential for future habitation, are also excluded. A specific area of the Rio Grande National Forest near South Fork is included where detailed flood hazard information was available.

The two sources of flooding in Rio Grande County are the Rio Grande and South Fork Rio Grande. The Rio Grande was studied in detail in the vicinity of Monte Vista, Del Norte, and South Fork. The South Fork Rio Grande was studied in detail in the vicinity of South Fork.

The areas studied by detailed methods were selected based on the extent and validity of available hydrologic and hydraulic data.

2.2 Community Description

Rio Grande County, encompassing a total area of approximately 913 square miles, is located in southwestern Colorado. Sagauche County lies to the north, Alamosa County to the east, Conejos County to the south, Archuleta County to the southwest, and Mineral County to the west. The incorporated communities in Rio Grande County (Monte Vista, Del Norte, and a portion of Center) have a combined

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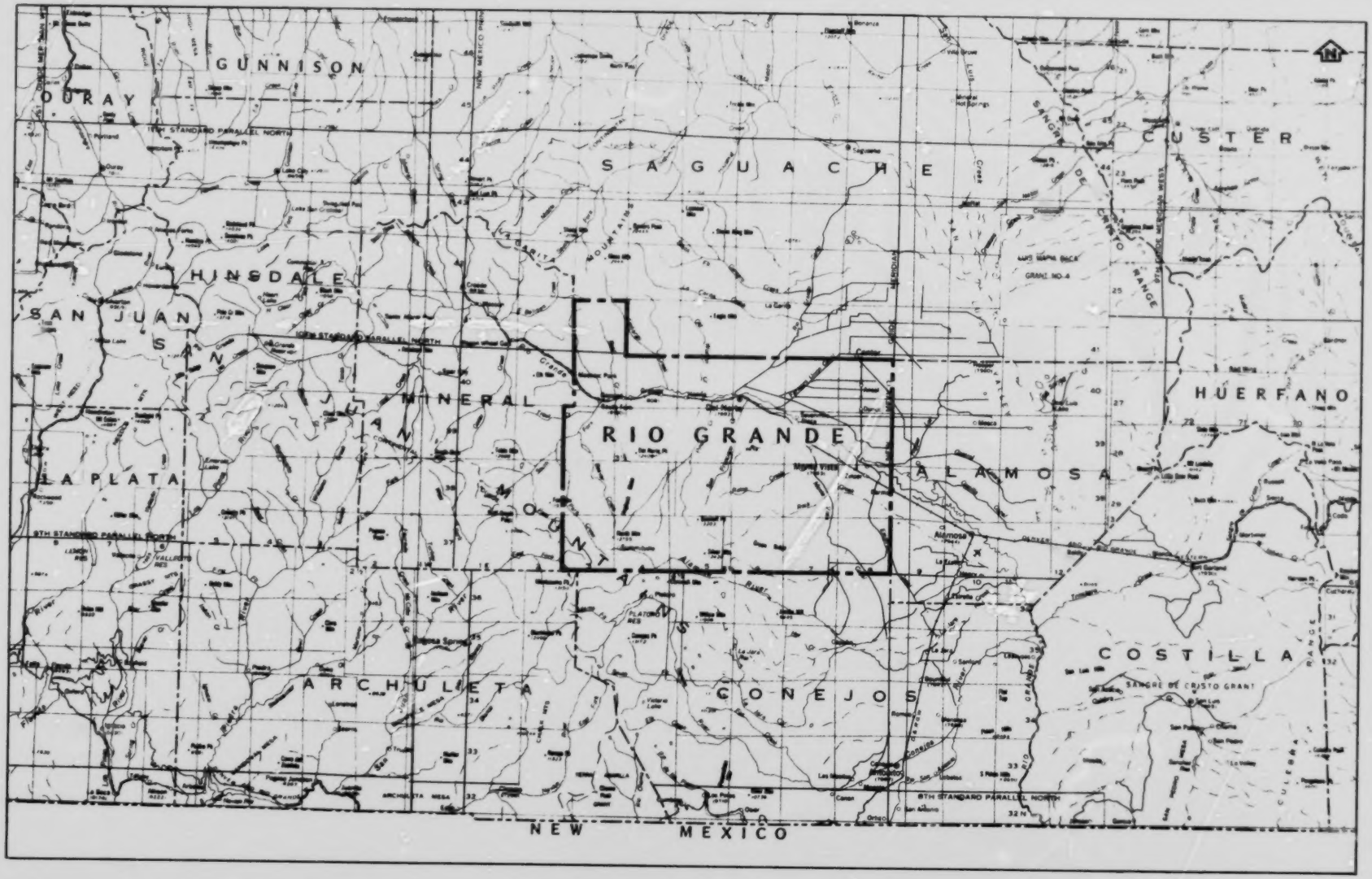

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

16 0 16 32 48 MILES

VICINITY MAP

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area of approximately 2 square miles. Economic activities in the area include timbering, farming, tourism, and small-scale mining.

Flood plain development is scarce, mostly consisting of ranches and farms. Residential development is increasing. Portions of the flood plains also have the potential for park and recreational uses, as well as a visual greenbelt.

The Rio Grande originates in southern Colorado and flows through New Mexico before becoming the boundary between the United States and Mexico. The South Fork Rio Grande is a major tributary to the Rio Grande. It drains the southern portion of the basin from the Wolf Creek Pass area, or approximately 217.5 square miles. Its confluence with the Rio Grande is located just to the north and east of the Town of South Fork. Also feeding the Rio Grande are several other tributaries that drain portions of San Juan, Hinsdale, Mineral, Sagauche, and Rio Grande Counties.

A number of irrigation ditches, such as Treasure Pass, Rober-Lohr, and Fachs ditches, convey water across natural drainage boundaries from the Colorado River basin. Several reservoirs also regulate flow in the basin. The Rio Grande is affected by the Beaver Creek, Santa Maria, Rio Grande, and Continental reservoirs.

The upper Rio Grande and South Fork Rio Grande basins compose the southwestern portion of the Upper Rio Grande Valley in Mineral and Rio Grande Counties. The valley occupies a long, narrow trough that was formed mainly by faulting. The main topographic features of this valley are the two parallel north-south mountain ranges that border the valley, the San Juan and La Garita Mountains in the west and the Sangre De Cristo Range on the east. The Sangre De Cristo Range merges with a low range of hills along the southern portion of the valley.

The San Juan Mountain Range is a well-defined area of rugged mountains rising above the San Luis Valley in the Rio Grande basin. The San Juan Mountains consist largely of volcanic rock in relatively horizontal layers overlying older sedimentary rock. Soils are moderately deep to shallow with rock outcrops. Permeability and runoff characteristics are highly variable.

Topography has a significant effect on the semiarid climate. The surrounding mountains act as a barrier, preventing the northern cold air or eastern storms from penetrating the Upper Rio Grande Valley.

Summers are cool in the study area, with temperatures occasionally reaching into the 90°F range. Temperatures for summer nights usually drop below 50°F. Winter temperatures, particularly in the

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daytime, are usually warmer than those found at similar or lower elevations. Periods of extreme cold temperatures are of short duration. The mean annual temperature is 43.1°F. The average precipitation varies from 9.41 inches at Del Norte to over 40 inches in the higher mountain elevations, where most of the precipitation occurs as snow.

Vegetation varies considerably according to the elevation in the basin. Vegetation below 8,000 feet consists of pinion pine, juniper, and sage with sparse grass ground cover. Increased precipitation supports dense pine and aspen forests between this elevation and the timberline. Rock outcrops and tundra grasses predominate on the high mountain peaks, where climatic conditions are too severe for forest growth (References 1, 2, and 3).

2.3 Principal Flood Problems

Flooding in the study area can result from snowmelt runoff, general rainfall, cloudburst storms, or any combination of the three.

Snowmelt runoff occurs from late May to early July. During this time, the study area is most susceptible to flooding, especially when temperatures are higher than normal or snowmelt is augmented with rain. This type of flooding has a long-duration runoff that results in a continuous rise in water level, producing high volumes of runoff.

Most of the annual rainfall occurs from July to October. Resultant flooding is of short duration, characterized by high peaks and low volumes of runoff.

The potential for the most severe flooding is created by the combination of rapid snowmelt with long-duration rainfall. Duration of flooding will vary, depending on the season in which flooding occurs. During the spring, when the streams are high because of snowmelt runoff coupled with spring rains, high water could persist for several days. During late summer, when the streams are normally low, runoff from thunderstorms will recede in a few hours.

Floodwaters flowing at high velocities create dangerous conditions. Velocities exceeding 3 feet per second with depths of 2 feet or more are generally considered hazardous. Those conditions would exist at several locations in the study area, especially in the river channels and low areas within the flood plain.

Detailed information on floods before 1900 is very limited. Information on past flooding is based on newspaper accounts and interviews with longtime residents of the area. Large floods occurred in Rio Grande County in 1884, 1905, 1911, 1927, 1949, 1957, 1970, and 1973. These floods caused major damage; disrupted highway and railroad traffic and communication services; drowned livestock;

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and destroyed agricultural lands, irrigation stuctures, roads, railroads, bridges, and buildings.

The 1884 flood is considered the most severe flood known in Monte Vista; the estimated peak discharge was 20,000 cubic feet per second (cfs) at Alamosa, Colorado.

In June 1927, a peak flow of 18,500 cfs was recorded in Monte Vista. Flooding was caused by 4 days of cloudbursts and incessant rain.

The October 1911 flood is considered the most severe flood known in Del Norte. The Rio Grande inundated the railroad tracks just outside the depot. Water was also 1.5 to 2 feet deep at the intersection of 4th and Pine Streets. The flood was triggered by intense rains in the mountains over an extended period of time. Diversion ditches, canals, and arroyos carried almost twice as much water as compared with other years. The U.S. Geological Survey (USGS) has estimated the flow to have been 18,000 cfs (Reference 4). This represents a recurrence interval of greater than 500 years.

The highest flood of record on the South Fork Rio Grande was that of October 1911. It destroyed four bridges, including the Denver & Rio Grande Western Railroad bridge near the mouth of the river. The gage was destroyed, but subsequent investigation found that the river began to rise at about 7:00 a.m. on October 5, and rose at a rate of approximately 1 foot per hour, overflowing its banks at approximately 11:00 a.m. It stayed at the highest stage until approximately 2:30 p.m. At 7:00 p.m., the river was again within its banks. From high-water marks, the peak discharge on the South Fork Rio Grande was estimated to be approximately 8,000 cfs. This flood discharge was greater than the discharge expected from a 100-year recurrence interval flood. The flood of June 1927, the highest since 1911, reached a stage approximately 1 foot lower than the flood of 1911, but no estimate of the discharge is available for the South Fork Rio Grande (References 1, 2, and 3).

2.4 Flood Protection Measures

The Rio Grande Reservoir Dam was raised in 1979, with modifications made to the emergency spillway. The spillway capacity is 10,000 cfs. The estimated 100-year peak inflow is 5,600 cfs, which indicates that the 100-year recurrence interval flood will not overtop the dam.

Other than the dam, no other structural flood protection measures are known to exist in Rio Grande County.

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3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Peak discharges for the Rio Grande at Monte Vista were calculated using the methodology for ungaged sites as described in the Manual for Estimating Flood Characteristics of Natural Flow Streams in Colorado (Reference 5).

Peak discharges for the Rio Grande at Del Norte were estimated using a regional log-Pearson Type III analysis (Reference 6).

Peak discharges for the Rio Grande in the vicinity of the Town of South Fork were developed from frequency analyses of peak discharges for the Del Norte and Wason streamflow gages, which were active for 62 and 40 years, respectively.

Peak discharges for the South Fork Rio Grande segment of this study were based on the Town of South Fork stream gage No. 2195, with 53 years of data. Additional data from several other stream gages in the region were used for checking and correlation purposes.

Information from the U.S. Water Resources Council (Reference 6), the Colorado Water Conservation Board (Reference 5), and the USGS (Reference 4) were also used as major references.

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Peak discharge-drainage area relationships for the Rio Grande and South Fork Rio Grande are shown in Table 1.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Water-surface elevations for the 10-, 50-, 100-, and 500-year floods for the Rio Grande near Monte Vista and Del Norte were computed using the U.S. Army Corps of Engineers HEC-2 computer program (Reference 7).

Cross sections for this analysis were obtained from aerial photographs flown in May 1980 (References 8 and 9), together with appropriate field verification. All bridges and culverts were measured in the field to obtain elevation data and structural geometry.

Water-surface elevations for the Rio Grande in the vicinity of the Town of South Fork and the South Fork Rio Grande were computed using the U.S. Soil Conservation Service WSP-2 computer program (Reference 10). Cross section data and reach lengths were obtained from photogrammetric maps prepared especially for this study. The aerial photographs used in the preparation of maps were taken on June 18, 1975 (Reference 3).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Roughness factors (Manning's "n" values) were determined by field inspection. Ground level photography aided in the selection of roughness factors and aerial photographs were used to determine the limits of each roughness zone. The roughness values for the main channel of the Rio Grande ranged from 0.03 to 0.045; flood plain values ranged from 0.02 to 0.1 for all floods. These figures represent roughness factors observed at various points along the drainages in the study area.

Starting water-surface elevations for the Rio Grande at Monte Vista and Del Norte were computed using the slope-area method.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

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Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Rio Grande					
At Monte Vista	1,590	9,320	11,850	12,880	15,150
At Del Norte	1,320	7,701	9,879	10,734	12,608
South Fork Rio Grande					
Above Confluence With Rio Grande	217.5	2,990	5,090	6,250	9,690

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All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year flood plain boundaries and 100-year floodway to assist communities in developing flood plain management measures.

4.1 Flood Plain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at scales of 1:2,400 and 1:4,800, with a contour interval of 2 feet (References 3, 8, and 9).

The 100- and 500-year flood plain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year flood plain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE); and the 500-year flood plain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year flood plain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

Approximate 100-year flood plain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Map for Rio Grande County (Reference 11).

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself.

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One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this study was computed for certain stream segments on the basis of equal conveyance reduction from each side of the flood plain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated at selected cross sections (Table 2). In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

A floodway was computed for the South Fork Rio Grande, because detailed information was not available at the time this Flood Insurance Study was compiled. No floodway information was available for the Rio Grande near Monte Vista.

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Table 2. Floodway Data

FLOODING SOURCE		FLOODWAY			BASE FLOOD ELEVATION			
Cross Section	Distance[1]	Width (Feet)	Section Area (Square Feet)	Mean Velocity (Feet per Second)	Regulatory (Feet)	Without Floodway (Feet)	With Floodway (Feet)	Increase (Feet)
Rio Grande (Vicinity of Del Norte)								
A	725	838[2]	2,133	5.0	7,868.0	7,868.0	7,868.8	0.8
B	1,802	442[3]	1,358	7.9	7,869.8	7,869.8	7,870.6	0.8
C	2,217	147[3]	1,075	10.0	7,871.6	7,871.6	7,871.9	0.3
D	2,387	1,360/800[4]	4,214	2.5	7,873.5	7,873.5	7,873.8	0.3
E	3,417	836/506[4]	2,308	3.0	7,874.9	7,874.9	7,875.0	0.1
F	3,872	475/360[4]	1,547	4.5	7,875.2	7,875.2	7,375.6	0.4
G	4,523	411	987	7.1	7,876.7	7,876.7	7,877.2	0.5
H	5,168	459	1,287	5.4	7,878.9	7,878.9	7,879.6	0.7

[1]Feet Above Downstream Limit of Detailed Study [2]Includes X-Zone Islands [3]Floodway Lies Entirely Within Town of Del Norte [4]Width/Width Within Unincorporated Area

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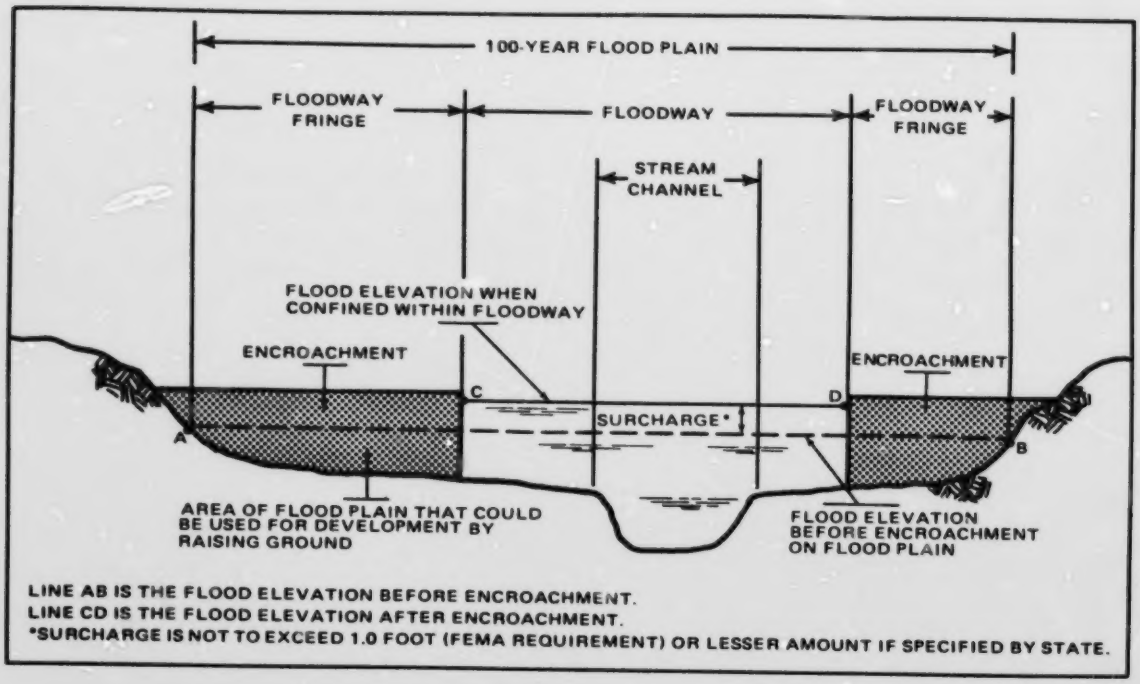
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year flood plains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year flood plains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

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Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year flood plain, areas within the 500-year flood plain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and flood plain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year flood plains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For flood plain management applications, the map shows by tints, screens, and symbols the 100- and 500-year flood plains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

Flood Insurance Studies have been published for the City of Monte Vista and the Town of Del Norte (References 1 and 2, respectively). The information presented in those studies is in general agreement with this study.

This Flood Insurance Study supersedes the Flood Hazard Boundary Map for Rio Grande County (Reference 11).

Flood Insurance Studies have been published for Alamosa and Archuleta Counties in Colorado, and are in general agreement with this study (References 12 and 13).

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8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Denver Federal Center, Building 710, Box 25267, Denver, Colorado 80225-0267.

9.0 BIBLIOGRAPHY AND REFERENCES

1. Federal Emergency Management Agency, Flood Insurance Study, City of Monte Vista, Colorado, 1982

2. Federal Emergency Management Agency, Flood Insurance Study, Town of Del Norte, Colorado, 1982

3. U.S. Department of Agriculture, Soil Conservation Service, Flood Hazard Study, South Fork Rio Grande and Rio Grande, in the Vicinity of South Fork, Colorado, October 1980

4. U.S. Department of the Interior, Geological Survey, Water-Supply Paper 1682, Magnitude and Frequency of Floods in the United States, Part 8, Western Gulf of Mexico Basins, James L. Patterson, 1965

5. Colorado Water Conservation Board, Technical Manual No. 1, Manual for Estimating Flood Characteristics of Natural Flow Streams in Colorado, 1976

6. U.S. Water Resources Council, "Guidelines for Determining Flood Flow Frequency," Bulletin 17, 1976.

7. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Computer Program, Davis, California, 1979

8. Landmark Mapping, Inc., Aerial Topographic Mapping, Scale 1:2,400, Monte Vista, Colorado (1980)

9. Landmark Mapping, Inc., Aerial Topographic Mapping, Scale 1:2,400, Contour Interval 2 feet: Del Norte, Colorado (1980)

10. U.S. Department of Agriculture, Soil Conservation Service, Engineering Division, WSP-2 Water Surface Profiles, Computer Program, 1976

11. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Rio Grande County, Colorado (Unincorporated Areas), Scale 1:24,000, April 29, 1977

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12. Federal Emergency Management Agency, Flood Insurance Study, Alamosa County, Colorado (Unincorporated Areas), 1978

13. Federal Emergency Management Agency, Flood Insurance Study, Archuleta County, Colorado (Unincorporated Areas), 1979

Exhibit 3 - Elevation Reference Marks

REFERENCE MARK	FIRM PANEL	ELEVATION (FEET NGVD)	DESCRIPTION OF LOCATION
RM2	0114	7874.164	Del Norte, Rio Grande County, in Del Norte. N.E. ¼, Section 30, T. 40 N., R. 6 E. At intersection of Denver & Rio Grande Western Railroad and Spruce Street. At railroad station, north side of the west end of cement platform, bronze cap stamped 7876.
RM3	0230	7705.82	In south face of spike. Milepost 273.
RM6	0245	7640.09	Benchmark G-163. Bronze tablet stamped 7640, 61 feet south of Highway 160, 25 feet east of Gravel Road.
RM7	0240	7674.70	Benchmark 7676. Bronze tablet stamped 7676, at milepost 271 on south side of Denver & Rio Grande Western Railroad in stone post. Approximately 1.5 miles west of town.
RM8	0230	7670.03	Benchmark 7672. Bronze tablet stamped 7672 at Maxeyville, at junction of U.S. Route 285 and Maxeyville Road, approximately 2.5 miles north of town, 62.3 feet west of centerline of highway, 34.5 feet south of centerline of county road.
RM9	0245	7626.58	Benchmark 111-1. Chiseled cross on bridge abutment north end of bridge, west side of paved highway.
RM10	0240	7659.52	Benchmark 156. Chiseled cross on north end of concrete abutment, west of Broadway, north of 6th Avenue.
RM11	0070	8242.615	U.S. Coast and Geodetic Survey No. 2, 1934, 10/18/43. Aluminum tablet stamped 8243. 3.85 miles northwest of South Fork, 1,800 feet west of Gatbreath's ranch, 200 feet east of milepost 302, 10 feet south of railroad, in side of cliff.

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Exhibit 3 - Elevation Reference Marks (Cont'd)

REFERENCE MARK	FIRM PANEL	ELEVATION (FEET NGVD)	DESCRIPTION OF LOCATION
RM12	0070	8188.87	Railroad spike painted 8189. 1.26 miles northwest of South Fork, 200 feet west of crossing, 20 feet south of railroad, in crossing signpost, 1 foot above ground.

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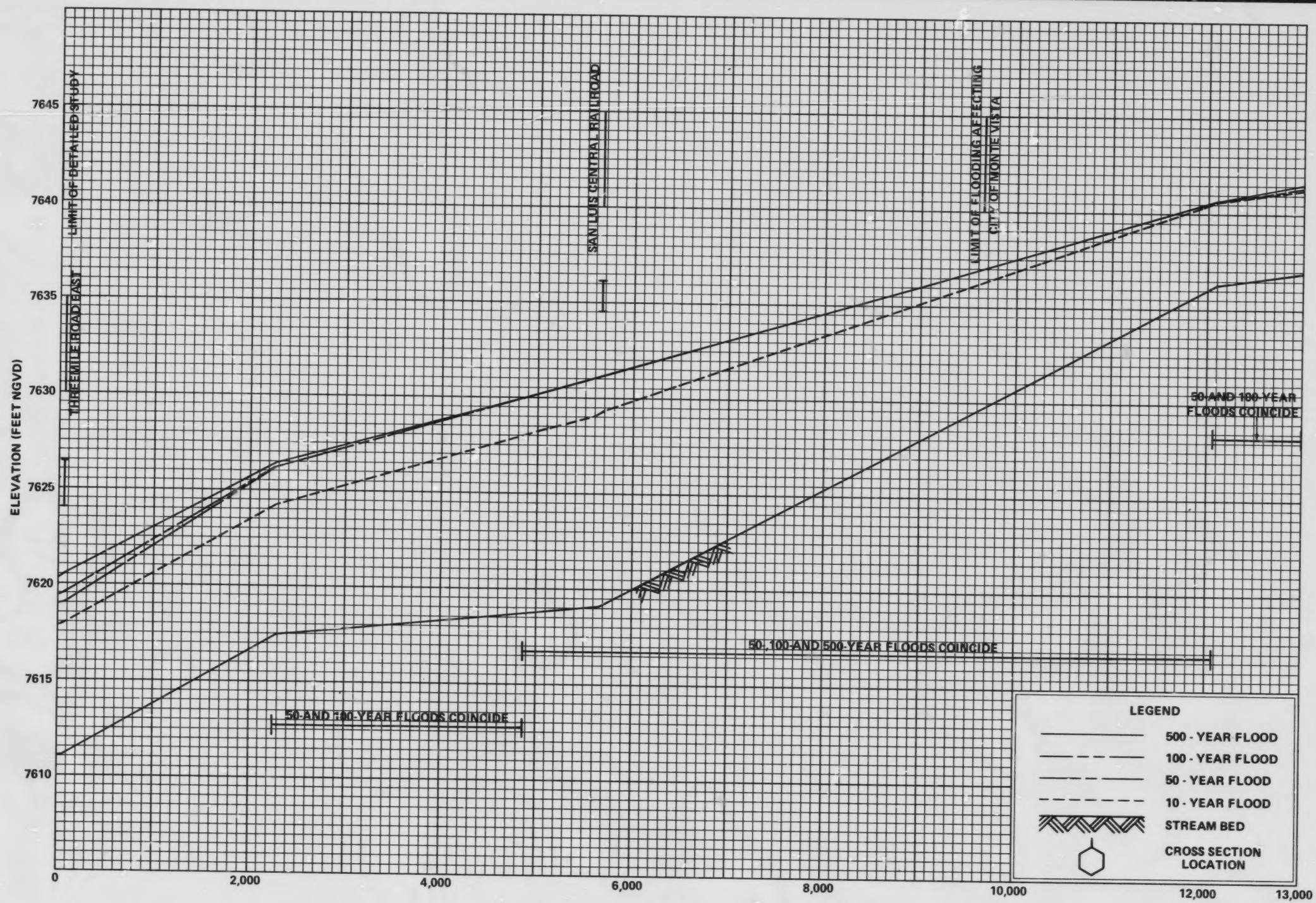

FLOOD PROFILES

RIO GRANDE (VICINITY OF MONTE VISTA)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

01P

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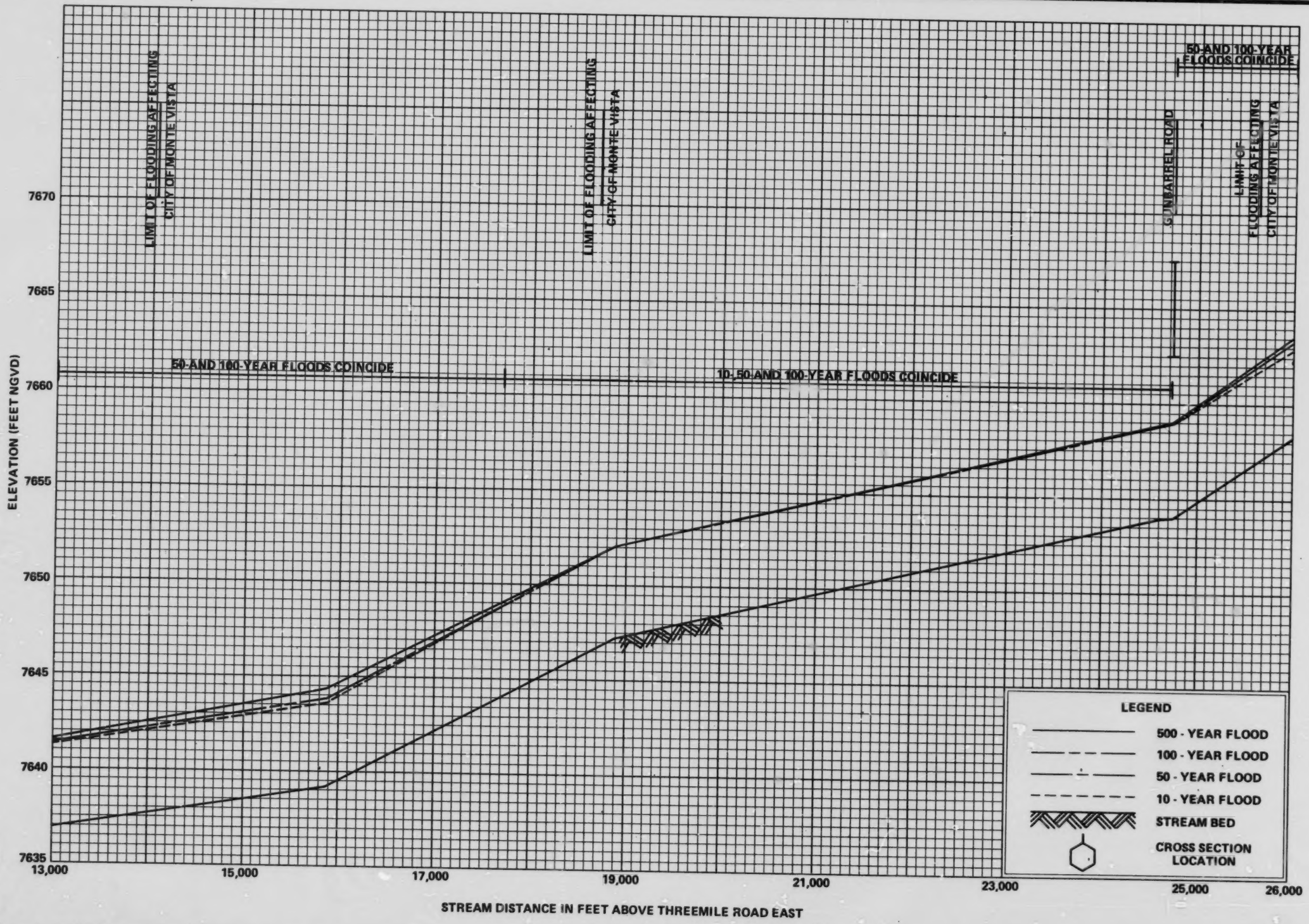

FLOOD PROFILES

RIO GRANDE (VICINITY OF MONTE VISTA)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

02P

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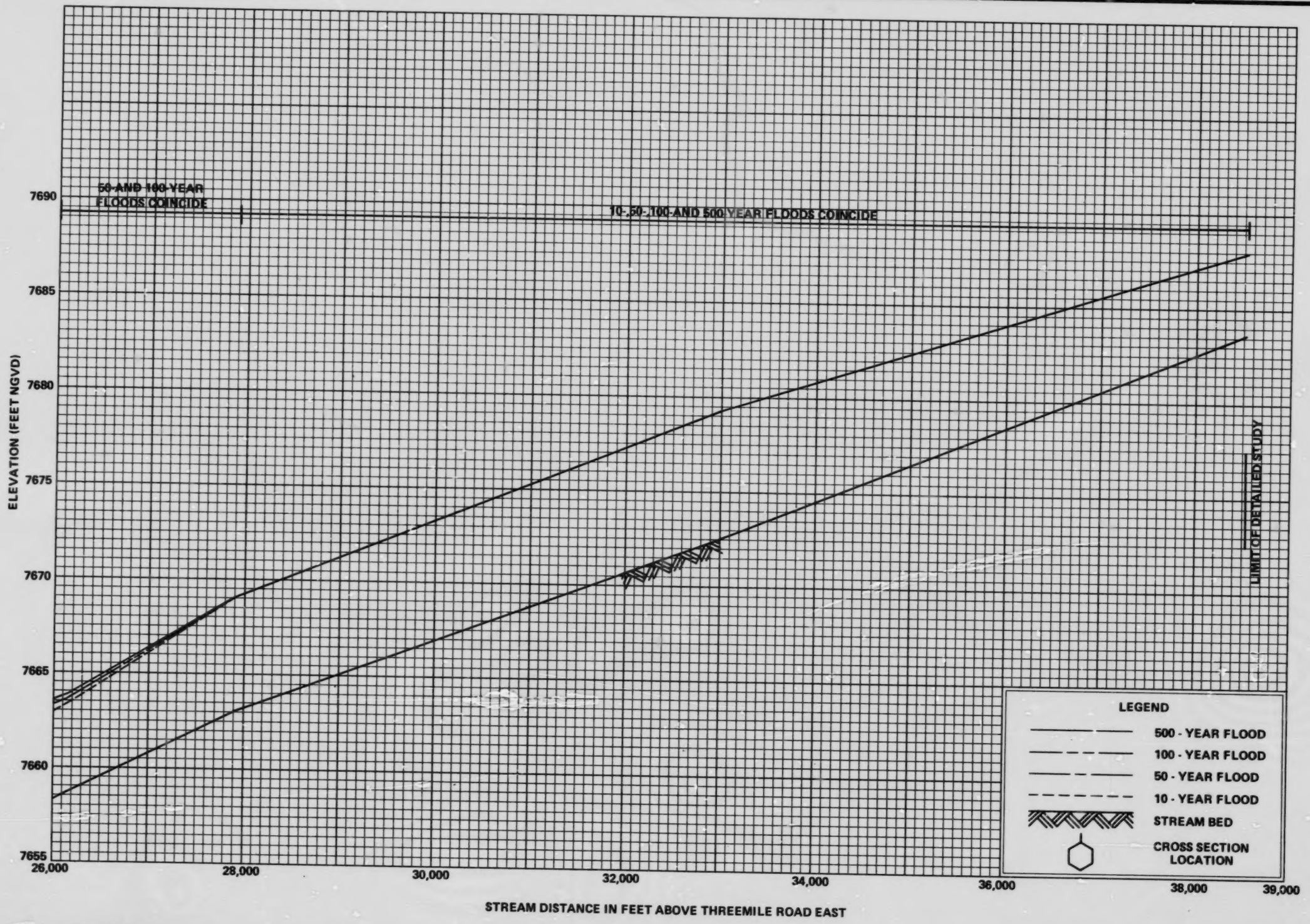

FLOOD PROFILES

RIO GRANDE (VICINITY OF MONTE VISTA)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

03P

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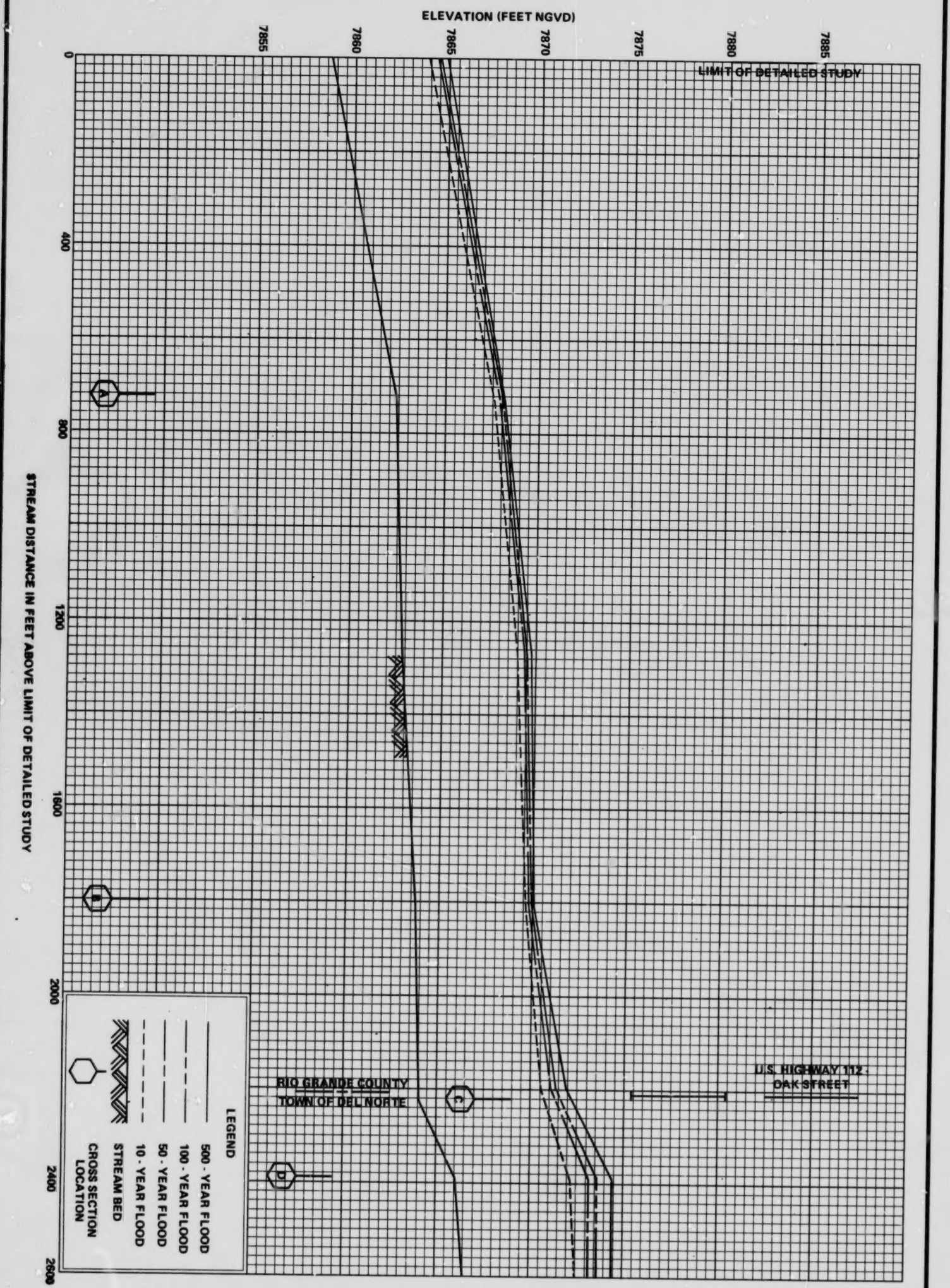

04P	FEDERAL EMERGENCY MANAGEMENT AGENCY RIO GRANDE COUNTY, CO (UNINCORPORATED AREAS)	FLOOD PROFILES RIO GRANDE (VICINITY OF DEL NORTE)

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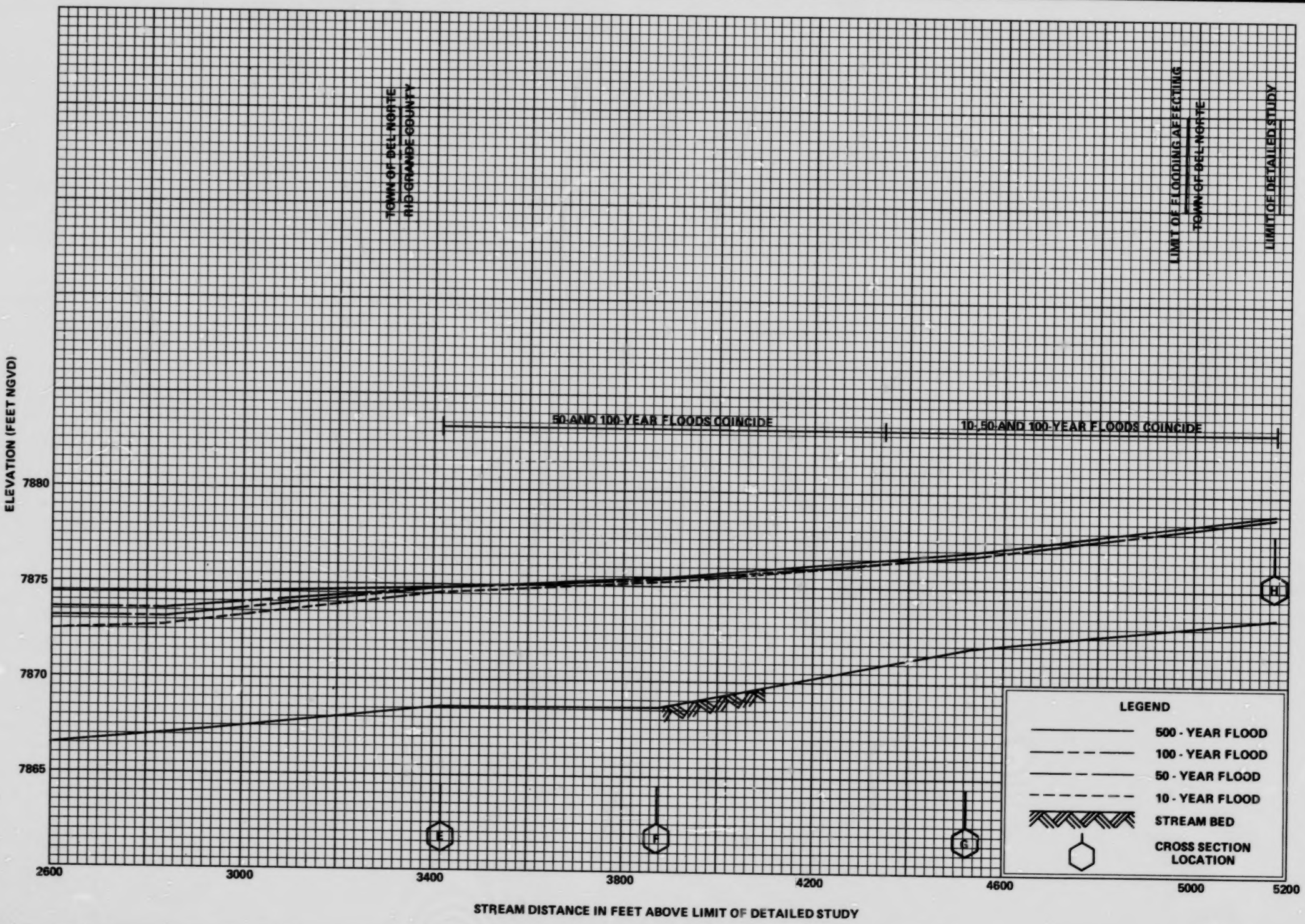

FLOOD PROFILES

RIO GRANDE (VICINITY OF DEL NORTE)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

05P

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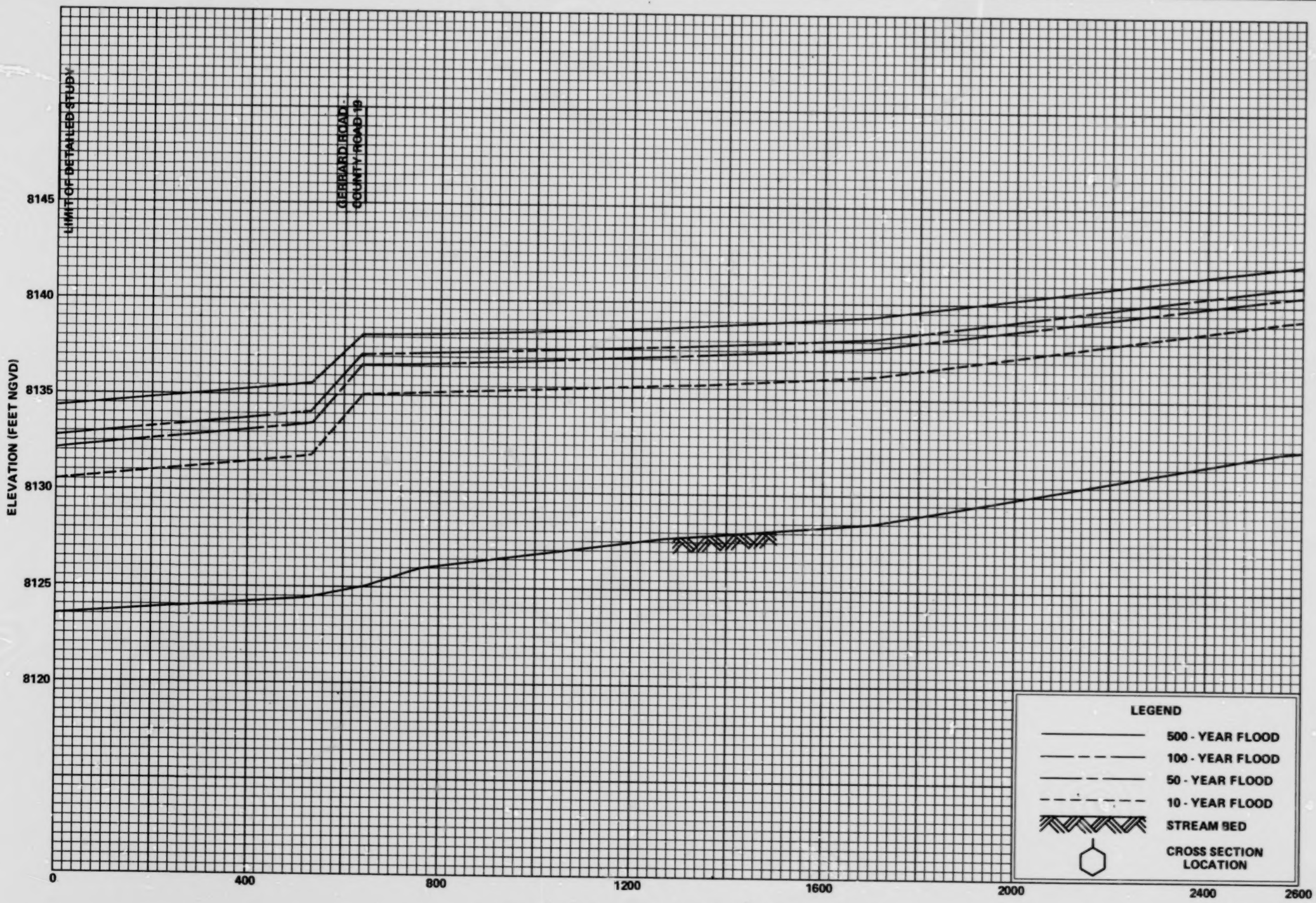

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

06P

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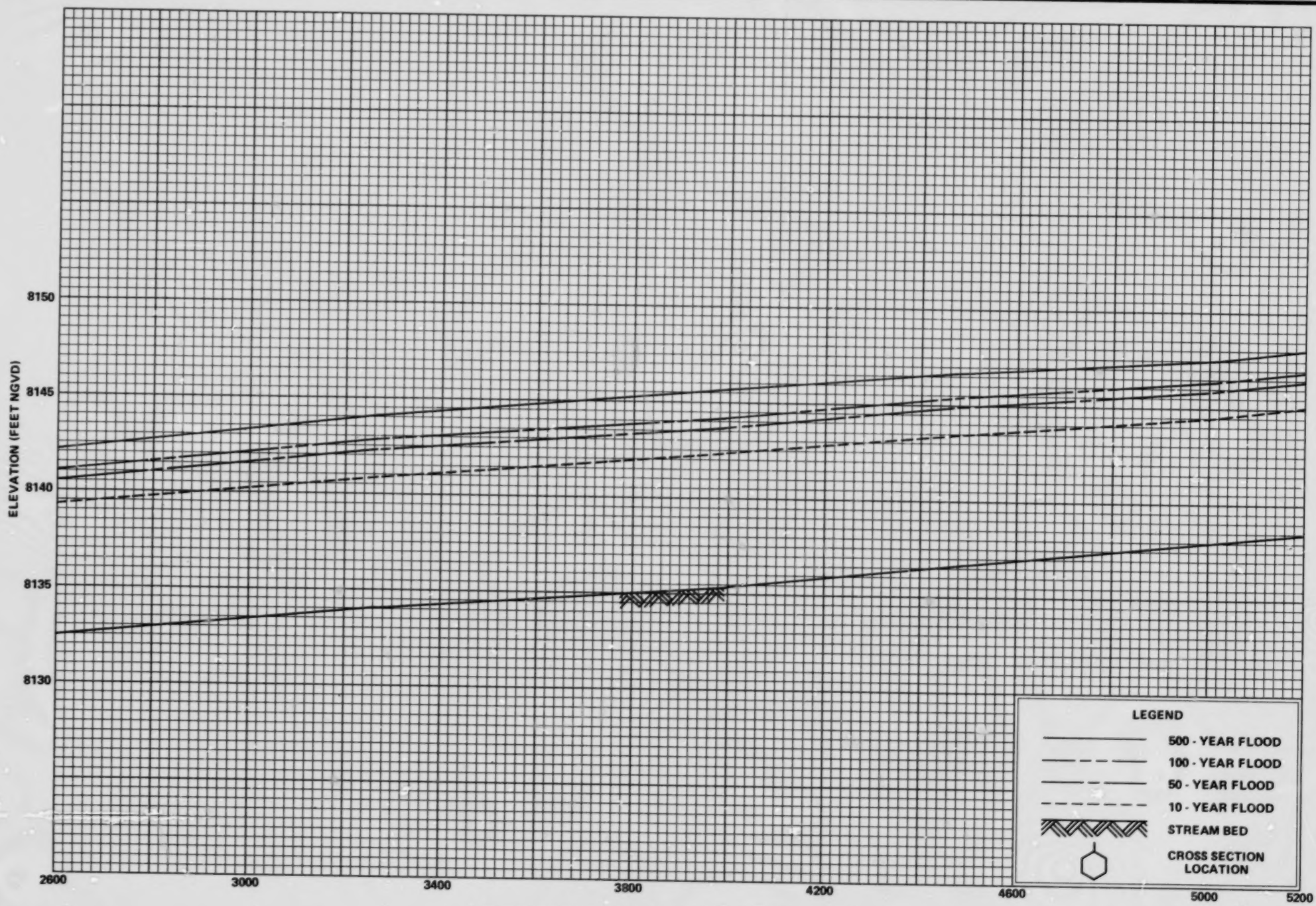

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

07P

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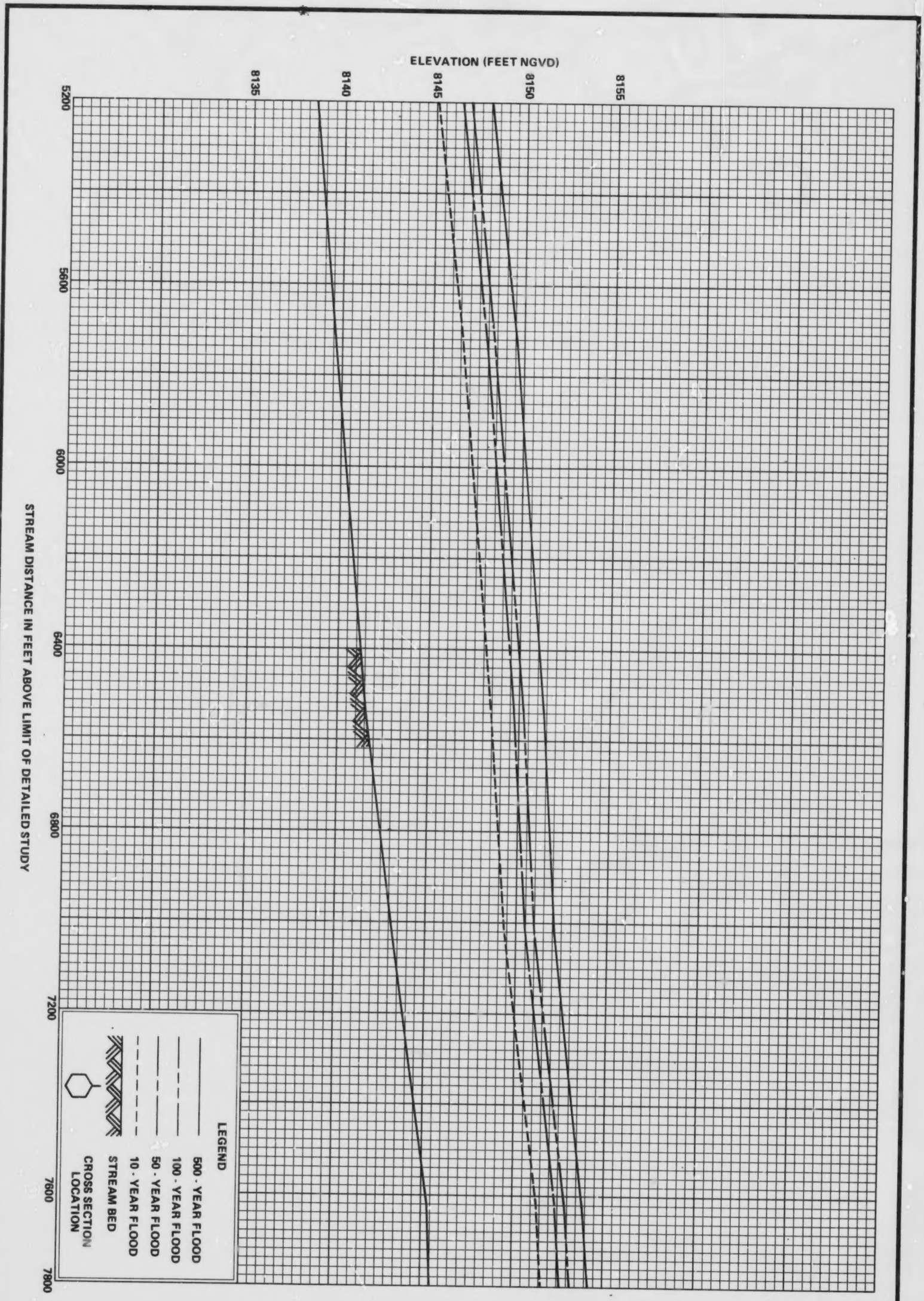

08P	FEDERAL EMERGENCY MANAGEMENT AGENCY RIO GRANDE COUNTY, CO (UNINCORPORATED AREAS)	**FLOOD PROFILES** RIO GRANDE (VICINITY OF SOUTH FORK)

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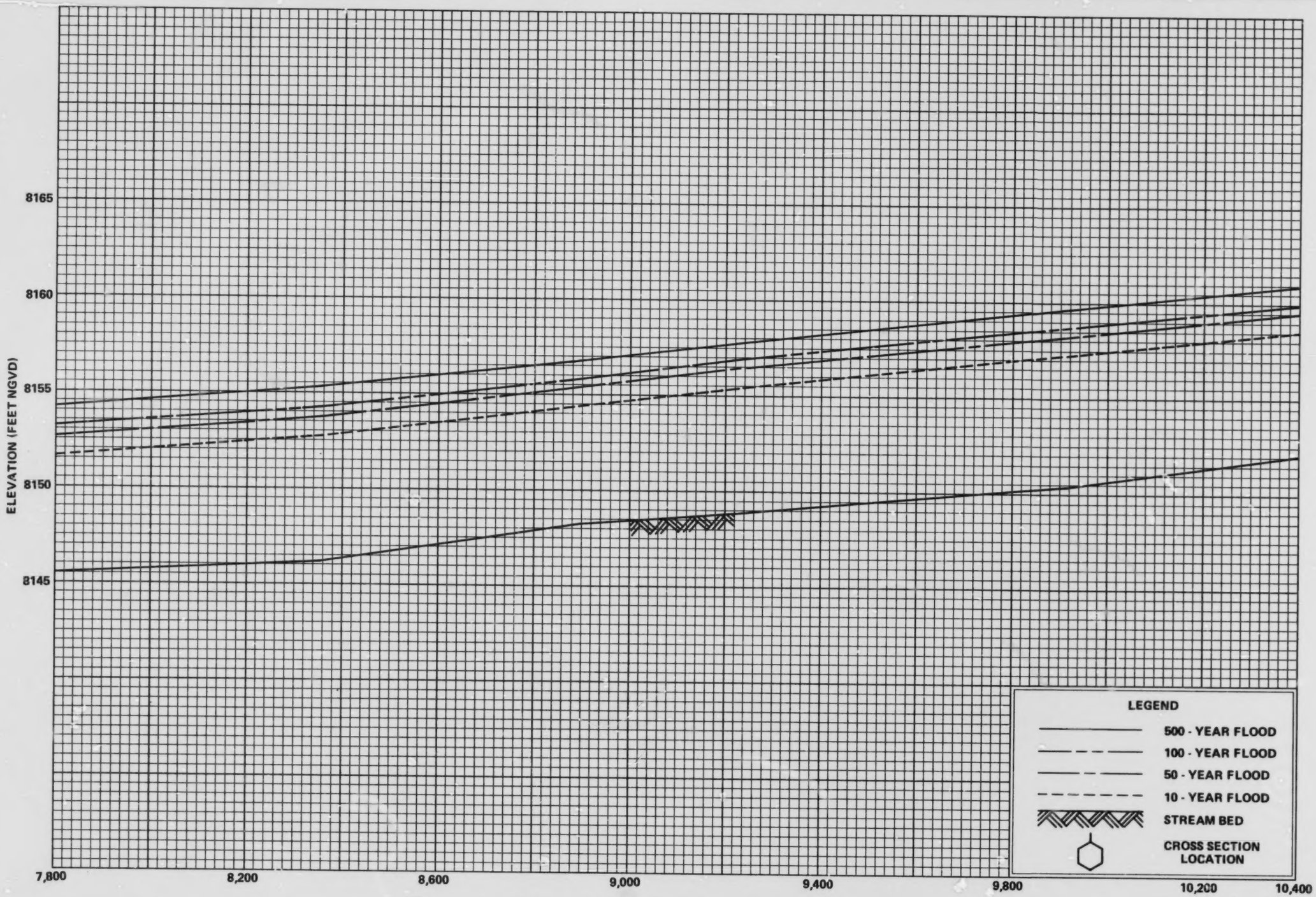
FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)



FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

09P

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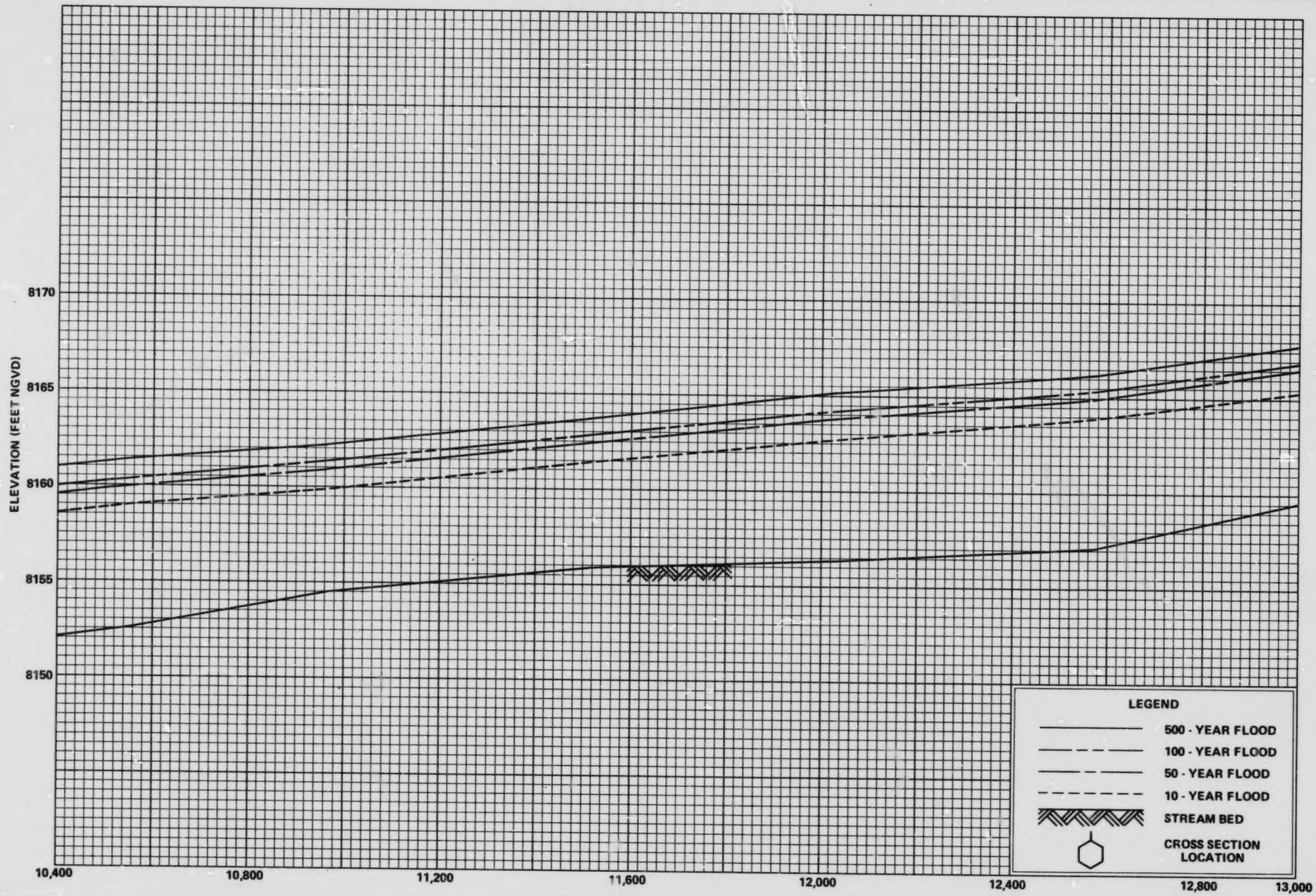

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

10P

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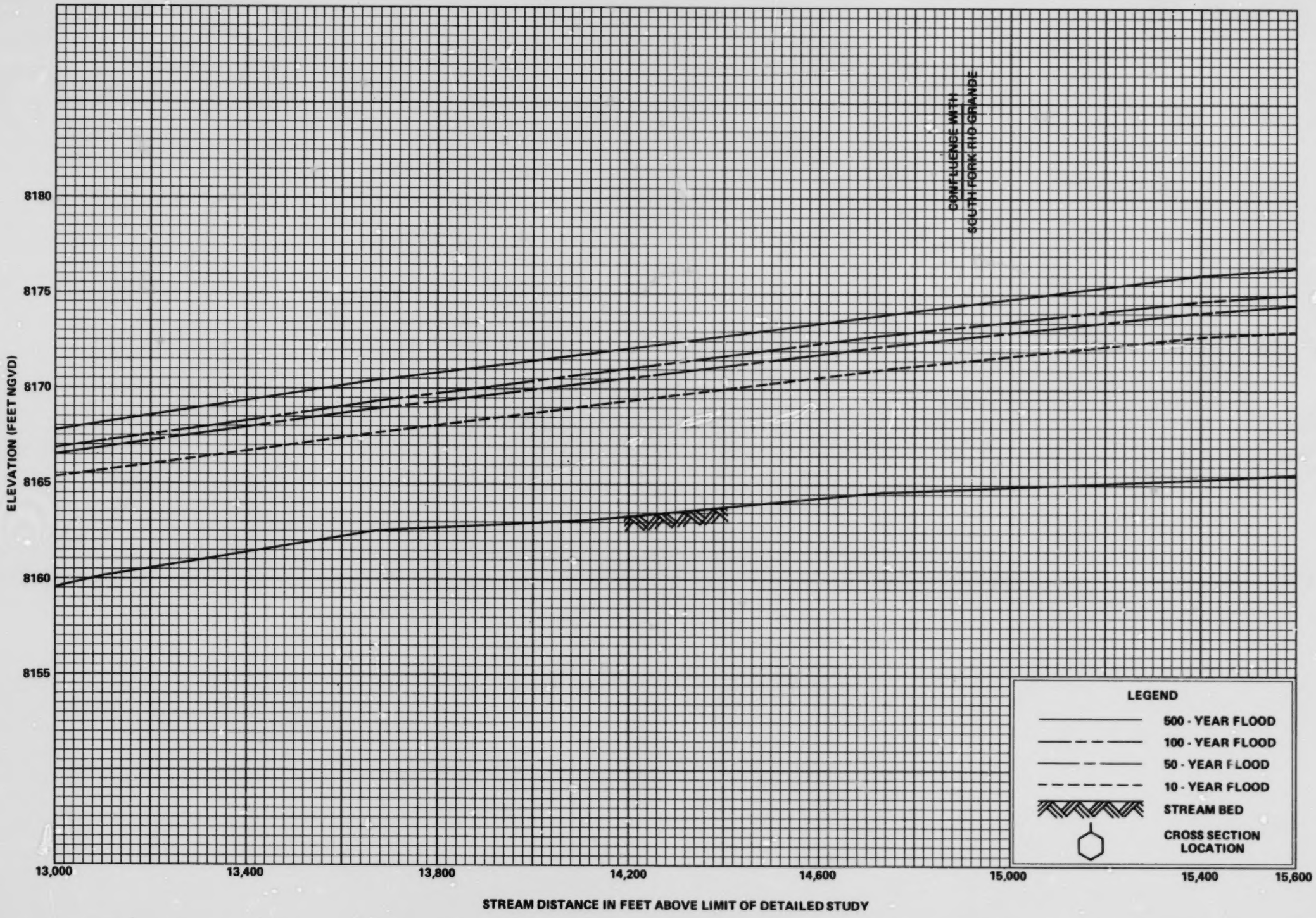

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

11P

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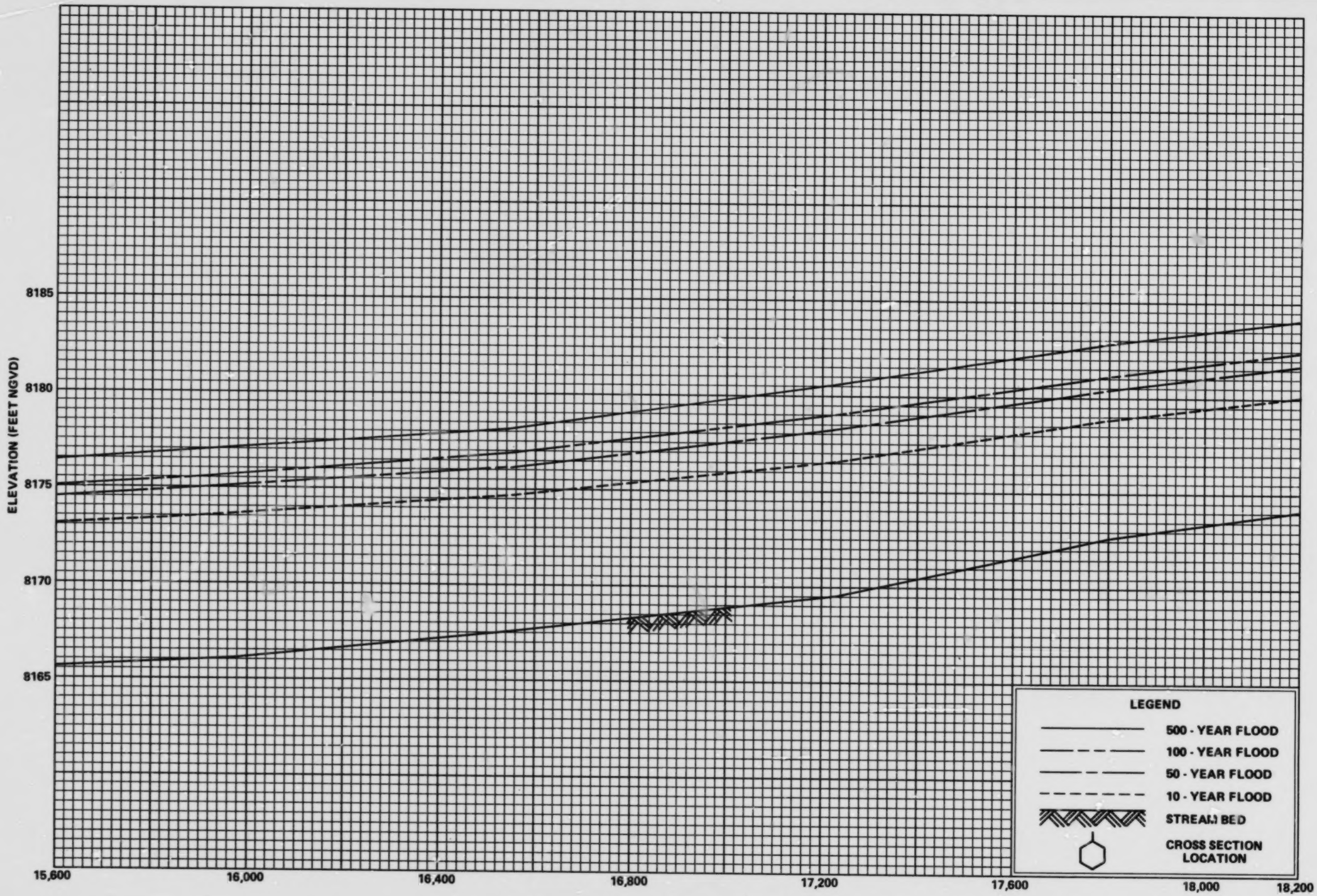

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

12P

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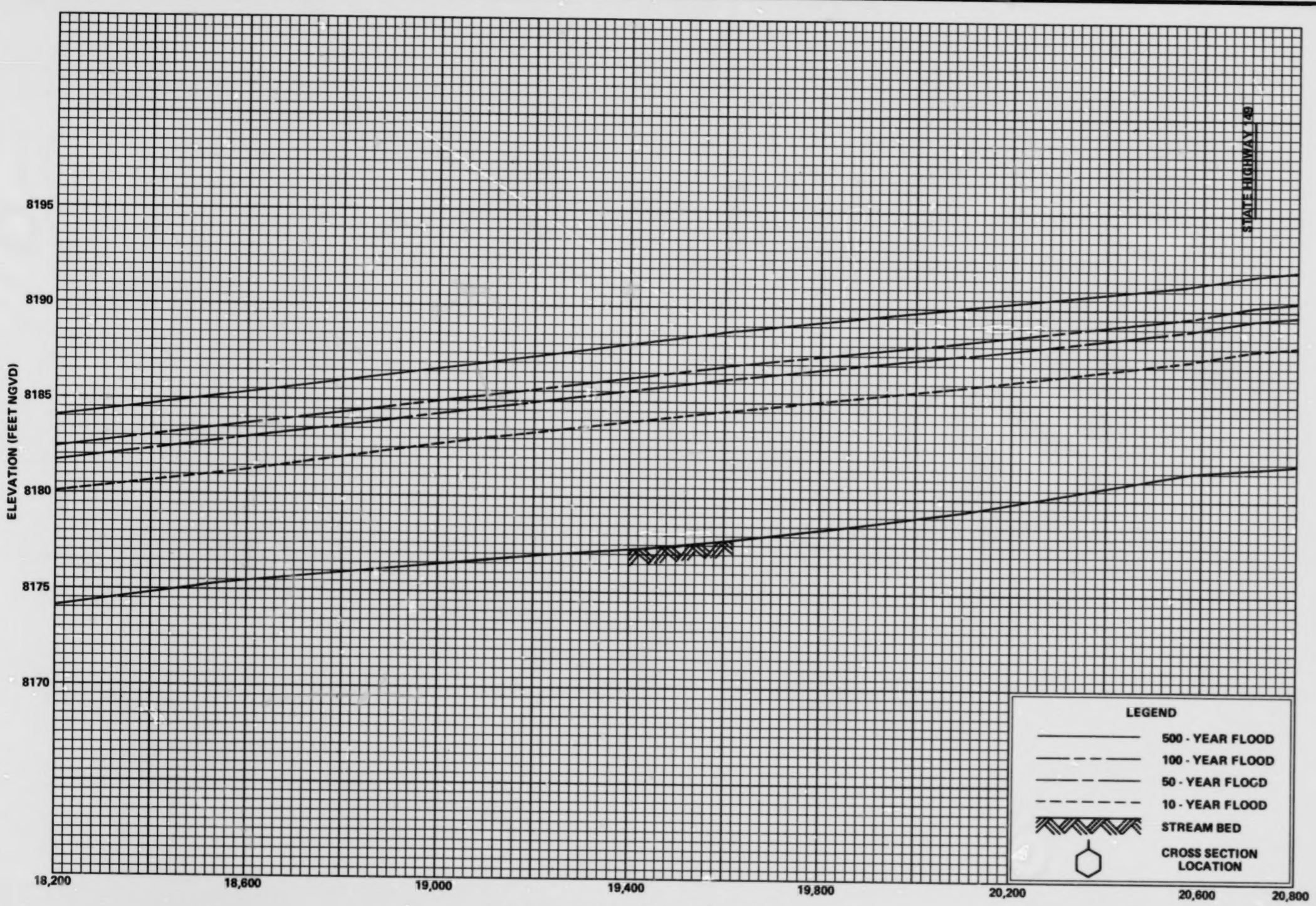

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

13P

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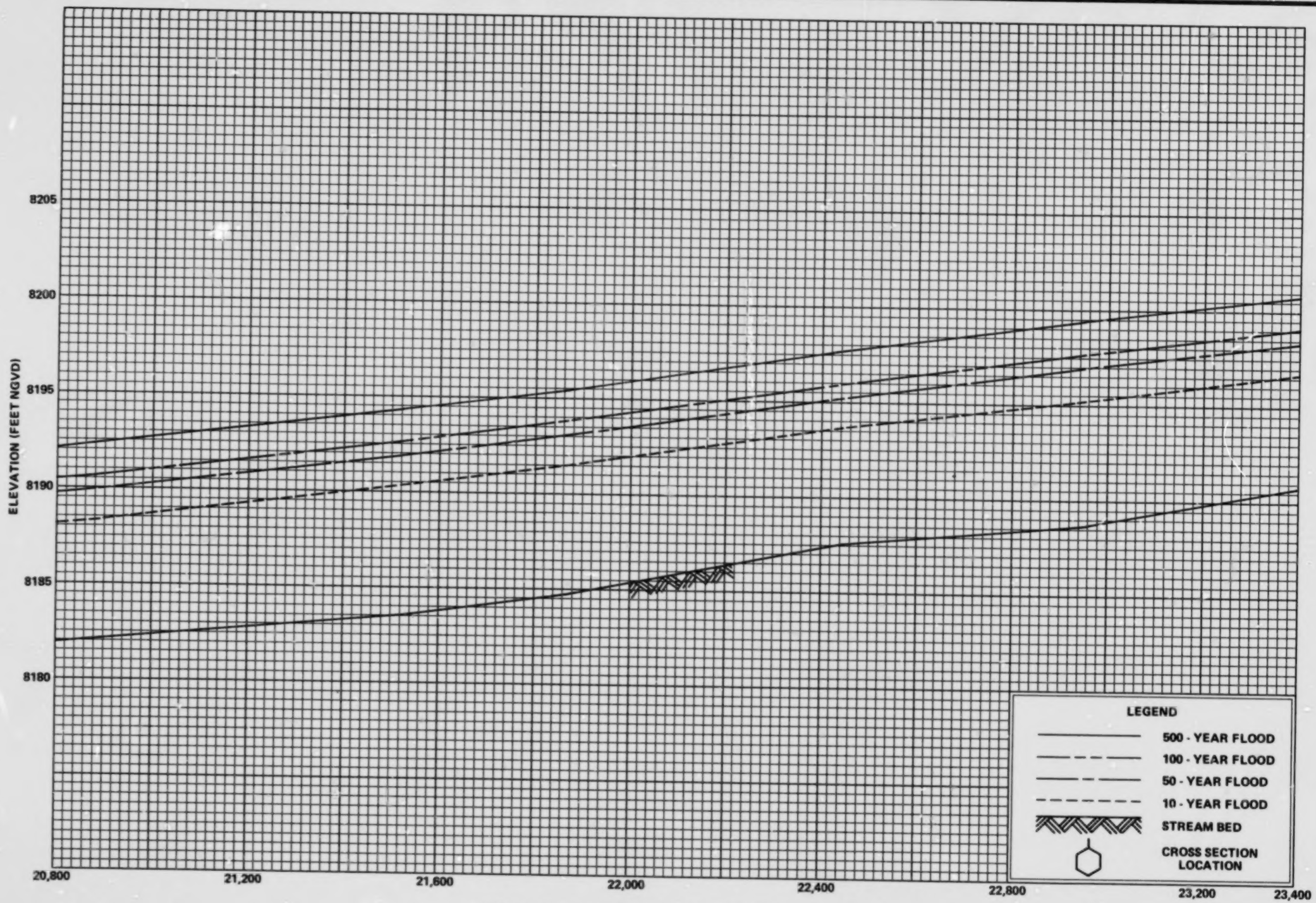

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

14P

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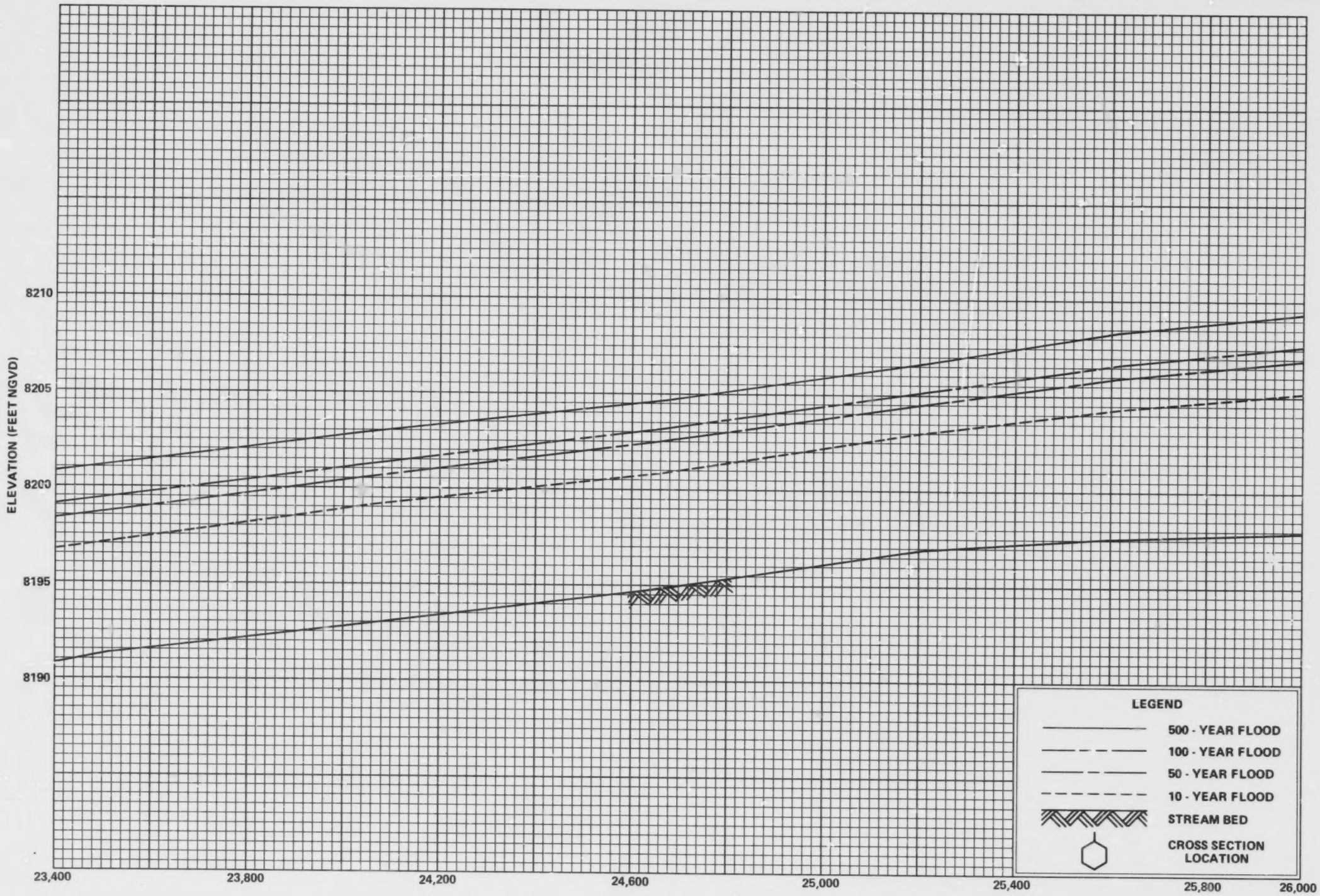

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

15P

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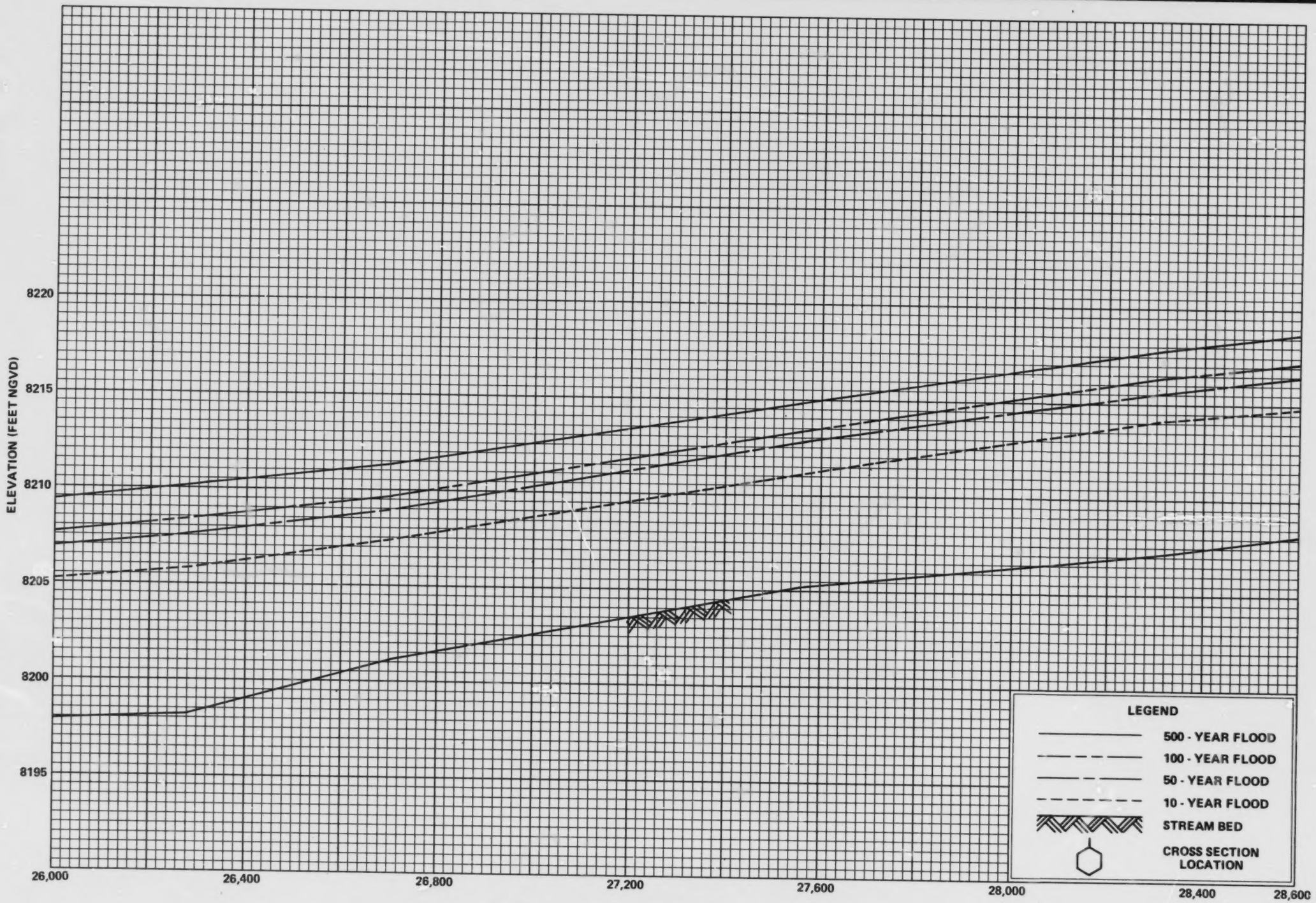

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

16P

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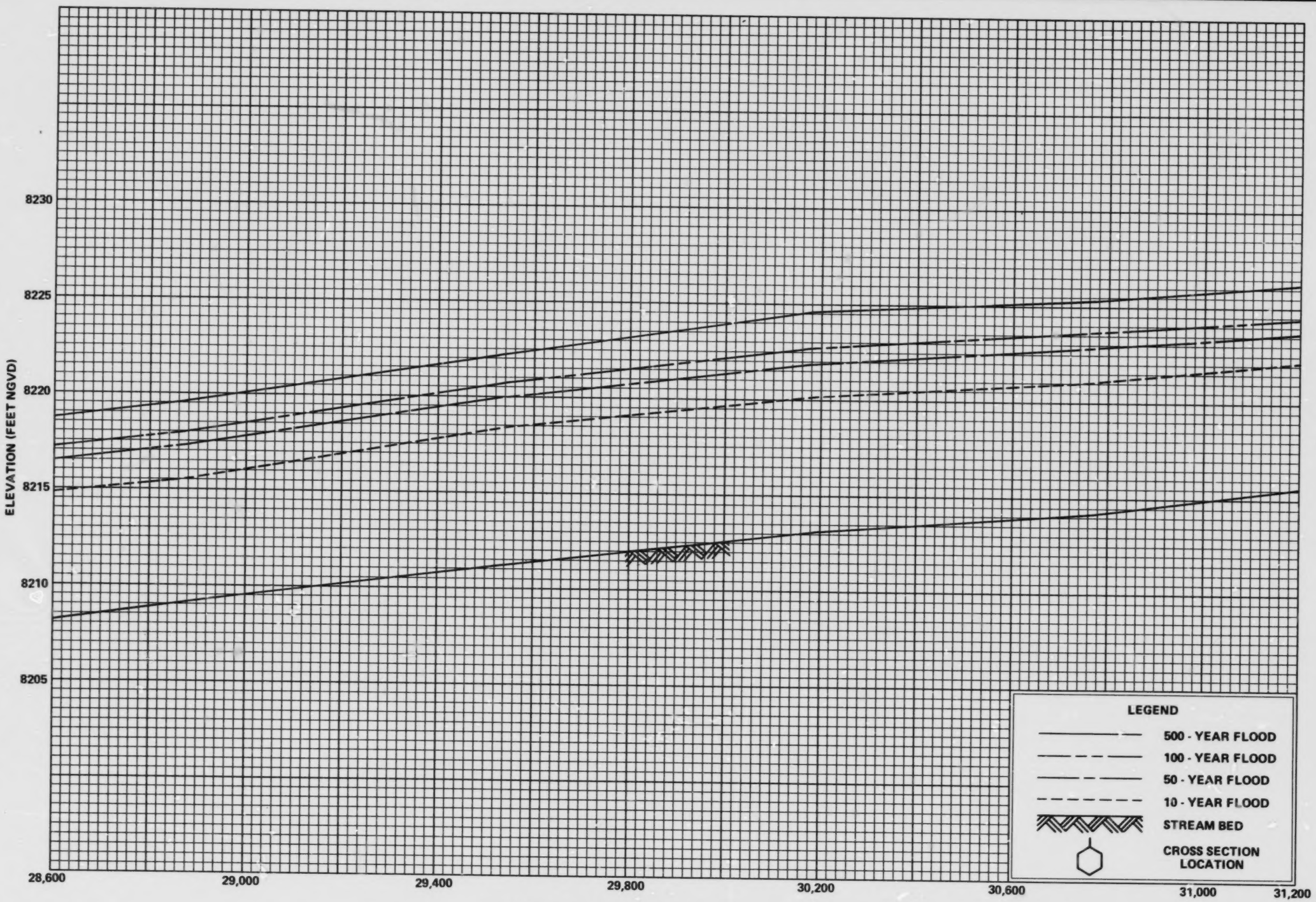

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

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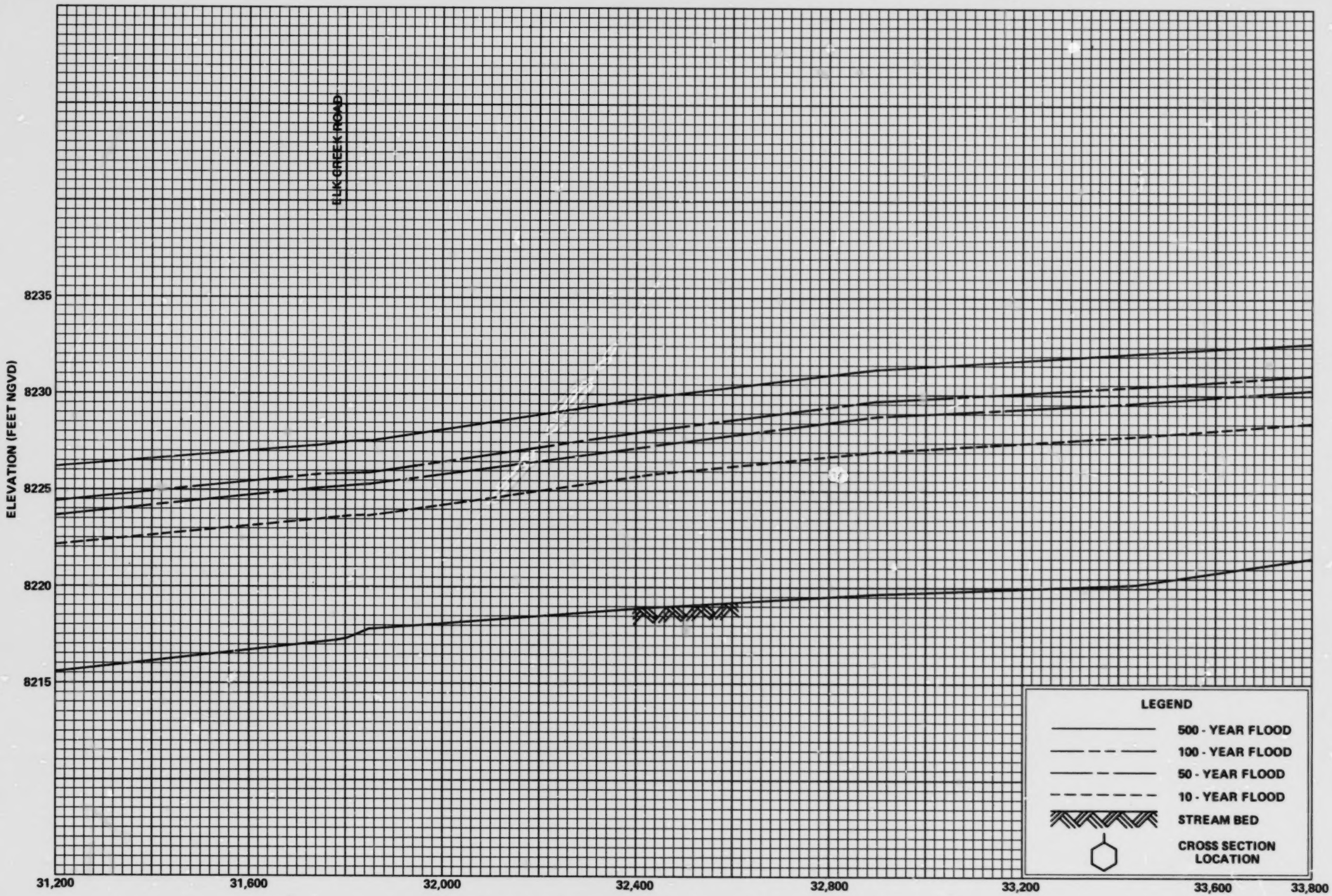

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

18P

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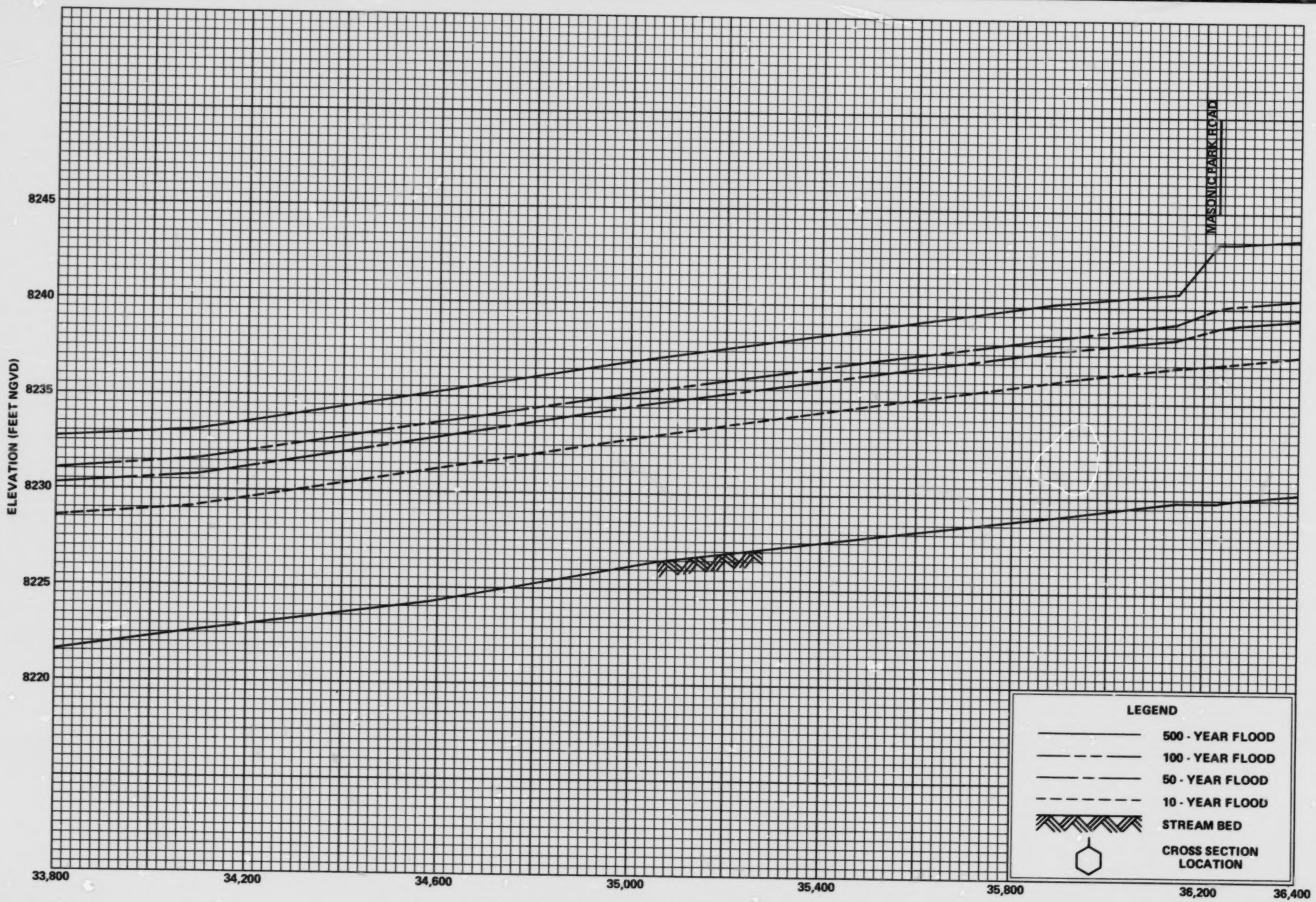

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

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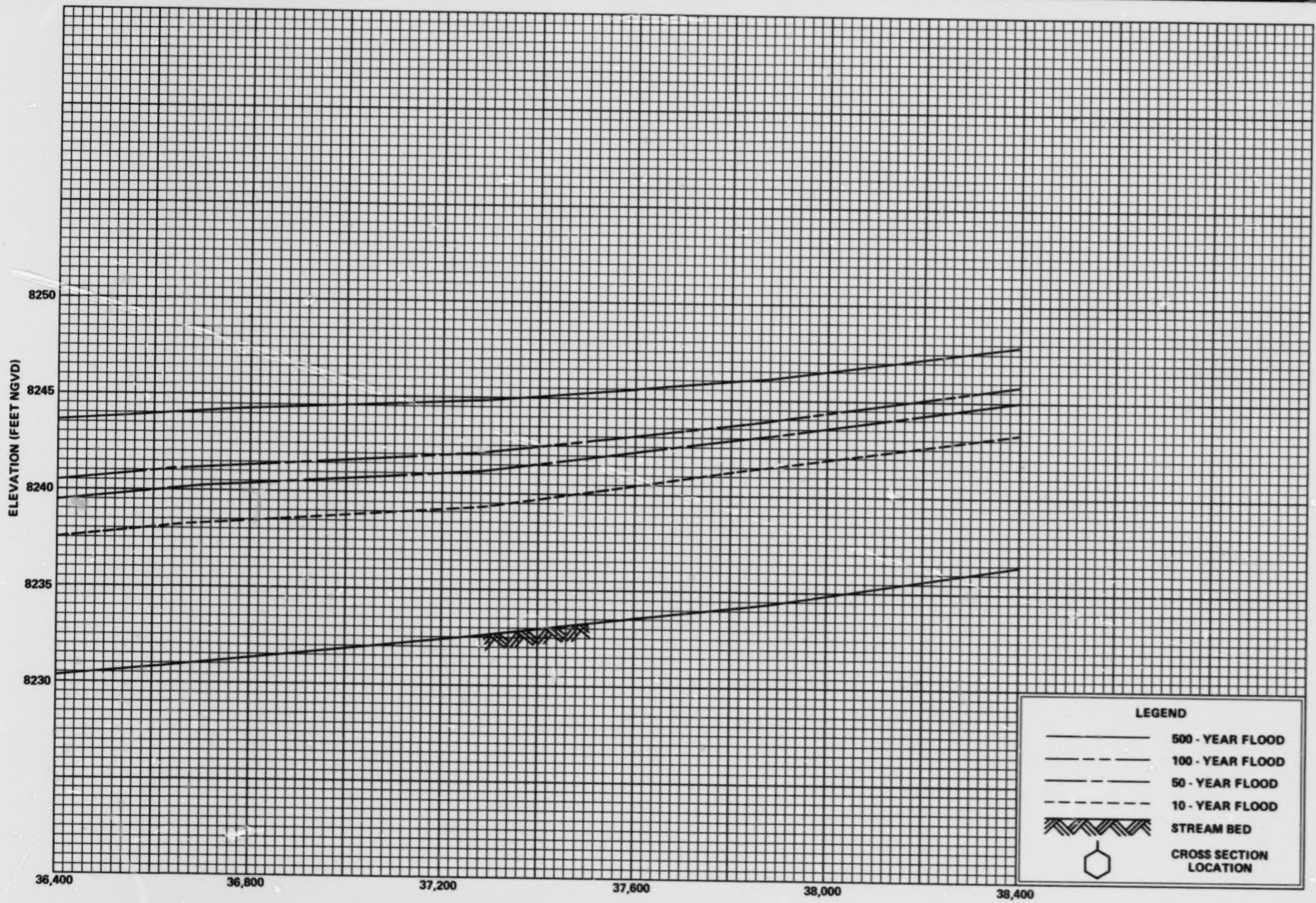

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

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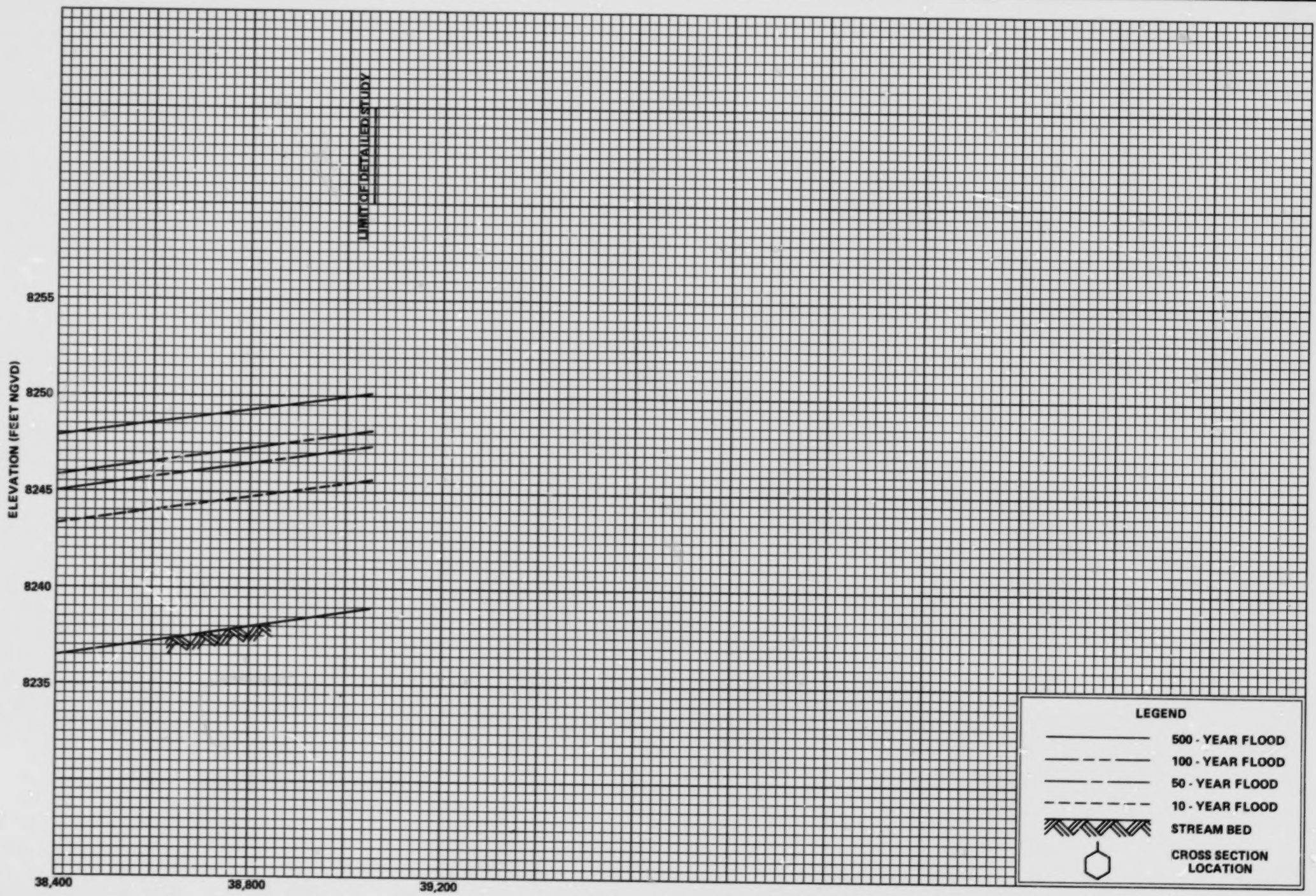

FLOOD PROFILES

RIO GRANDE (VICINITY OF SOUTH FORK)

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

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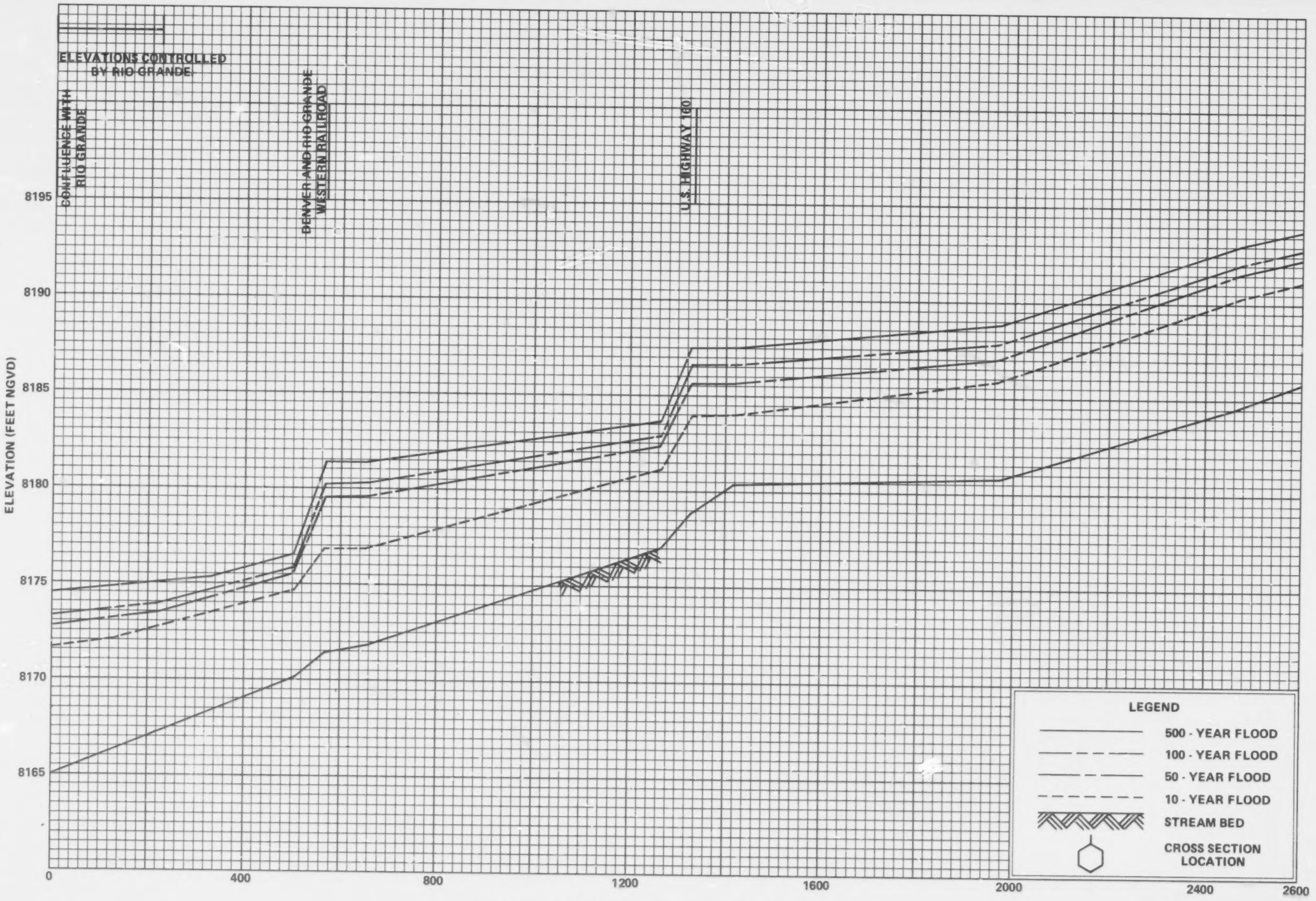

FLOOD PROFILES

SOUTH FORK RIO GRANDE

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

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FLOOD PROFILES

SOUTH FORK RIO GRANDE

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

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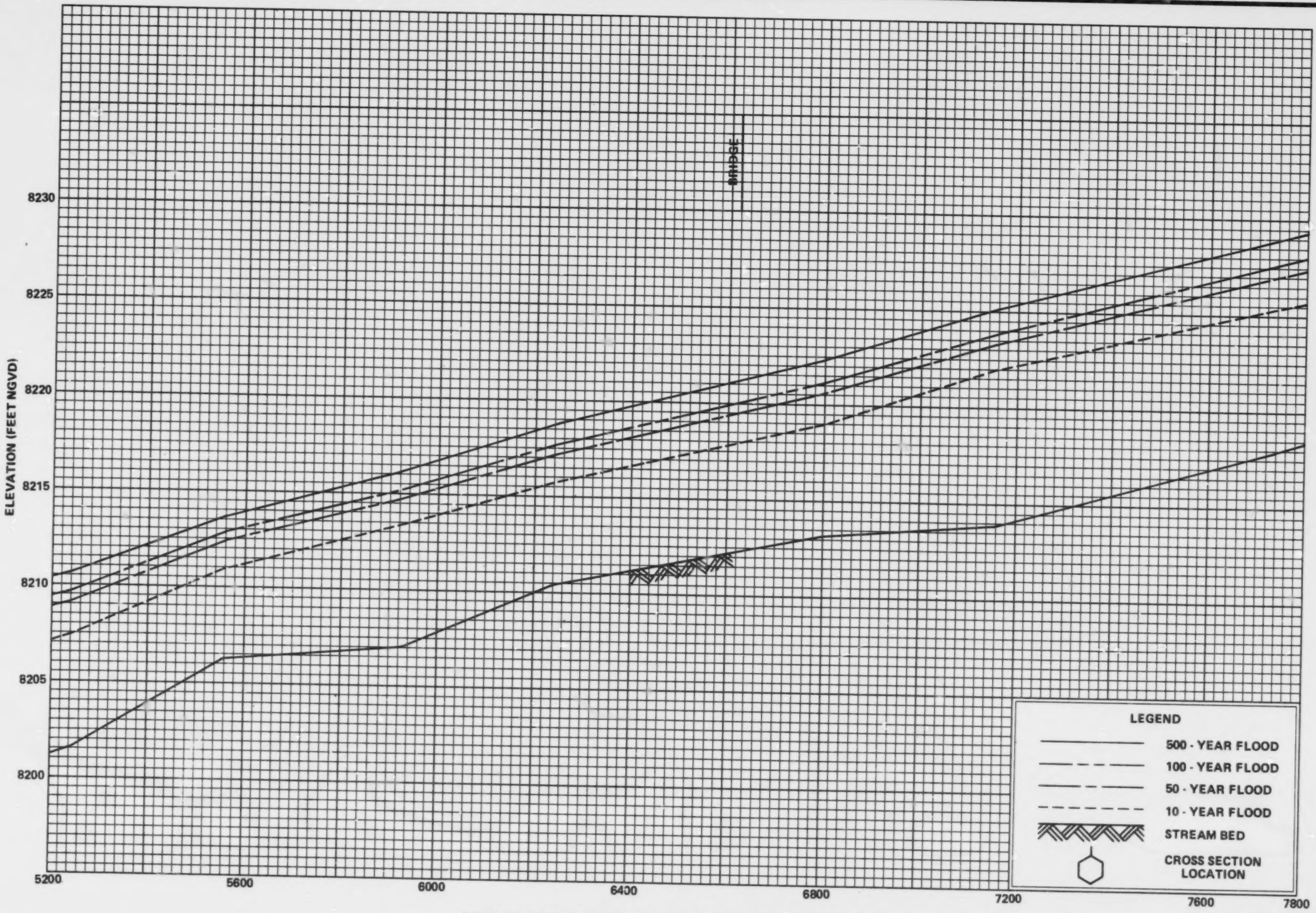

FLOOD PROFILES

SOUTH FORK RIO GRANDE

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

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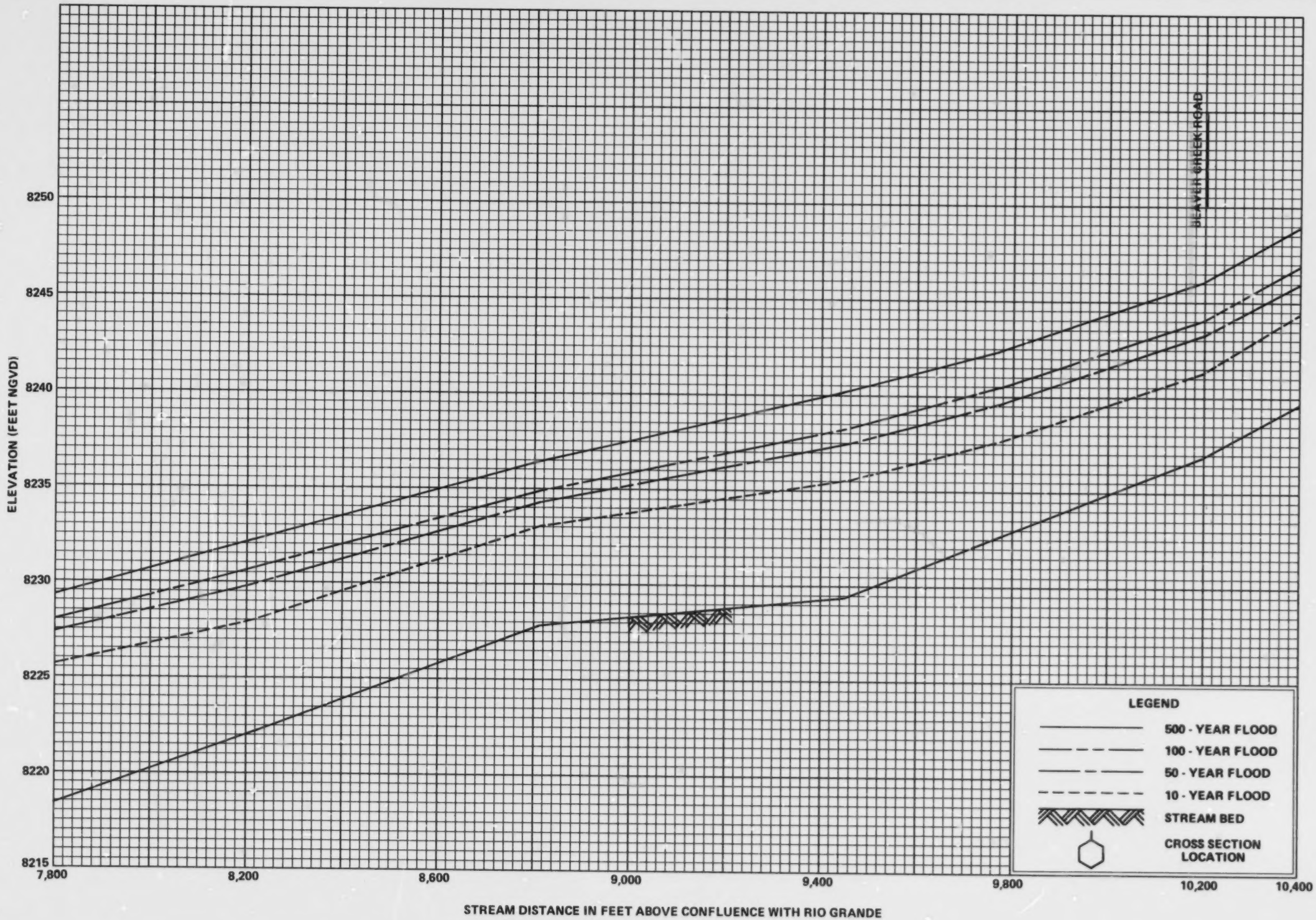

FLOOD PROFILES

SOUTH FORK RIO GRANDE

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

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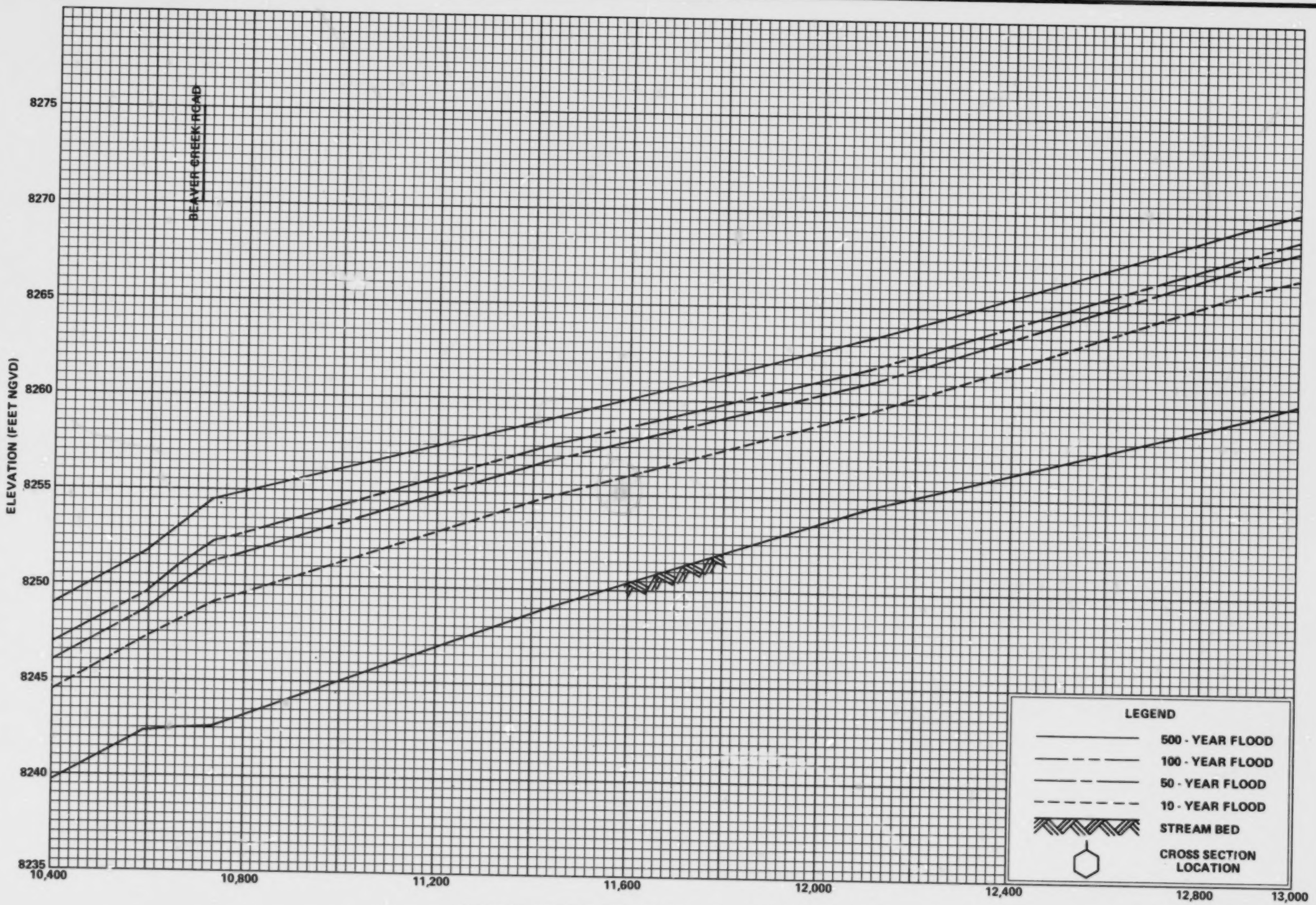

FLOOD PROFILES

SOUTH FORK RIO GRANDE

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

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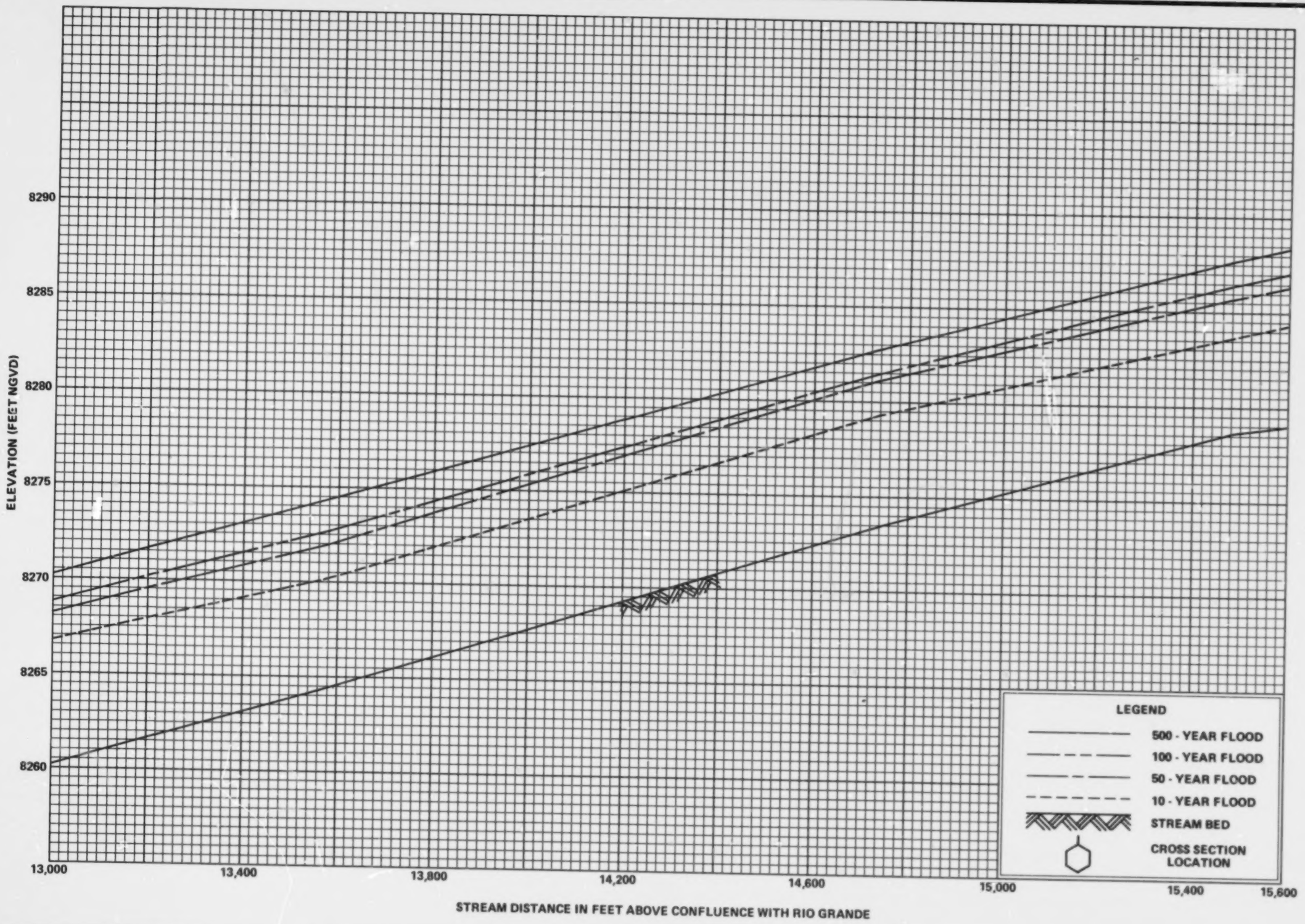

FLOOD PROFILES

SOUTH FORK RIO GRANDE

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

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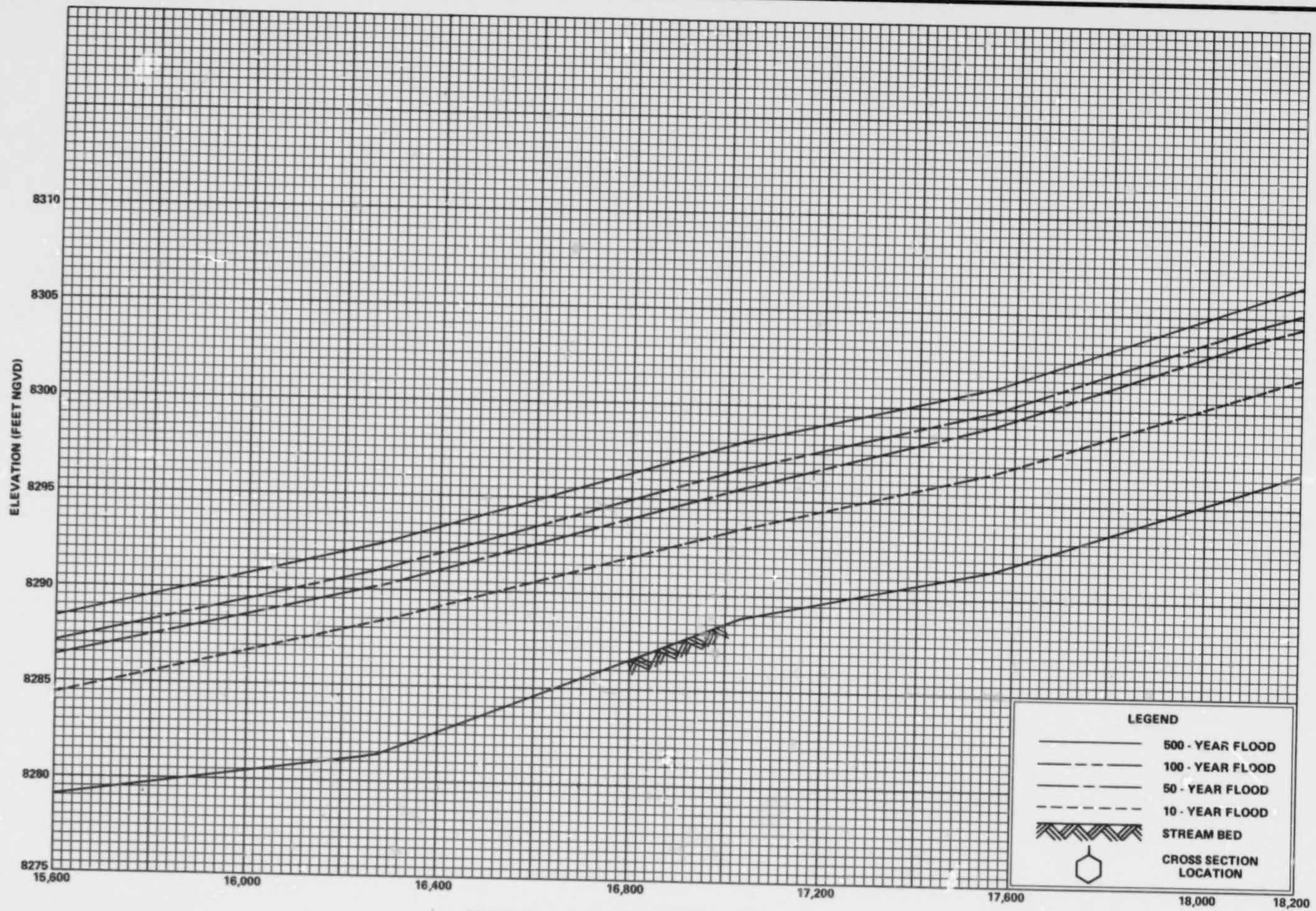

FLOOD PROFILES

SOUTH FORK RIO GRANDE

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

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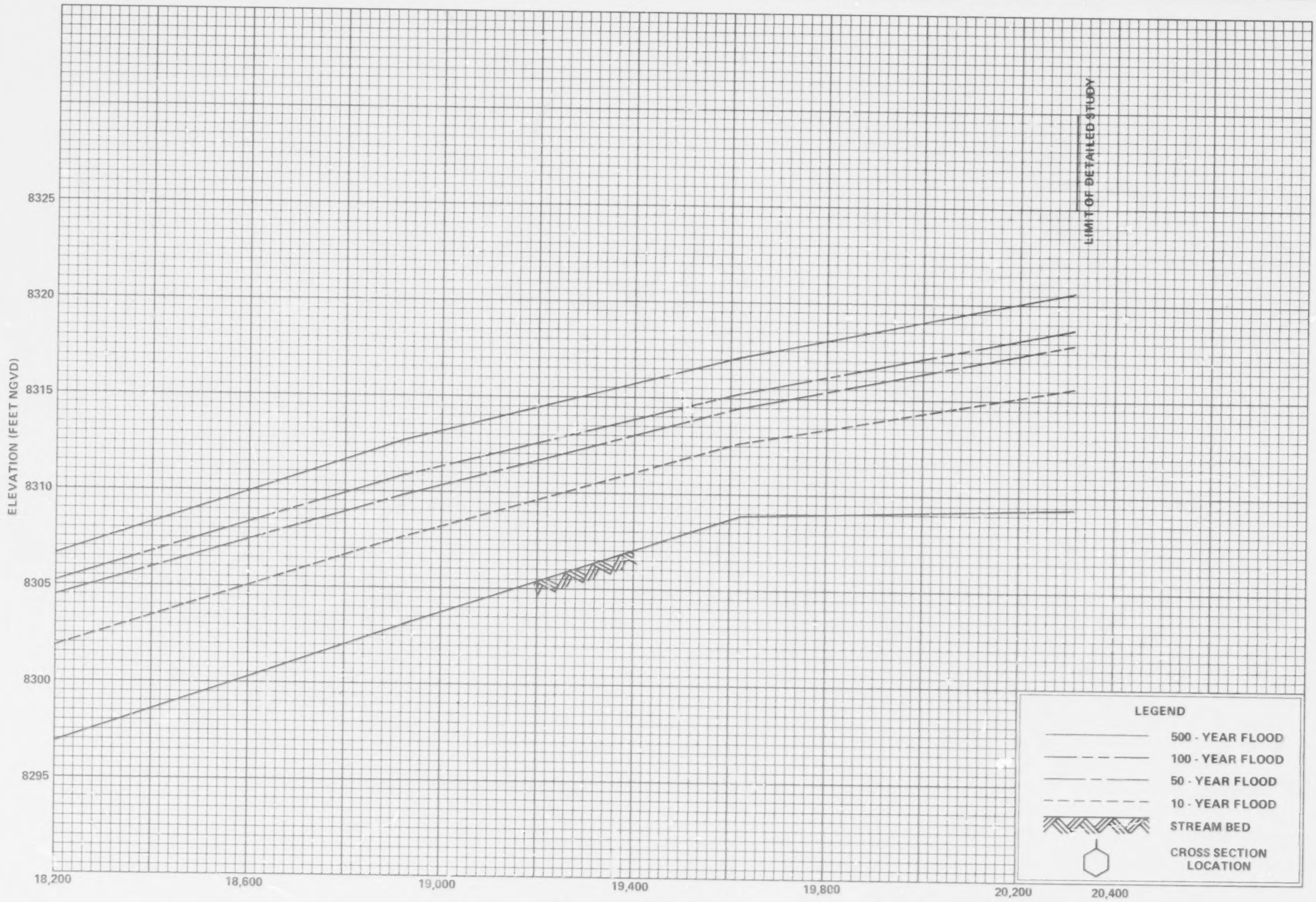

FLOOD PROFILES

SOUTH FORK RIO GRANDE

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIO GRANDE COUNTY, CO
(UNINCORPORATED AREAS)

29P

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